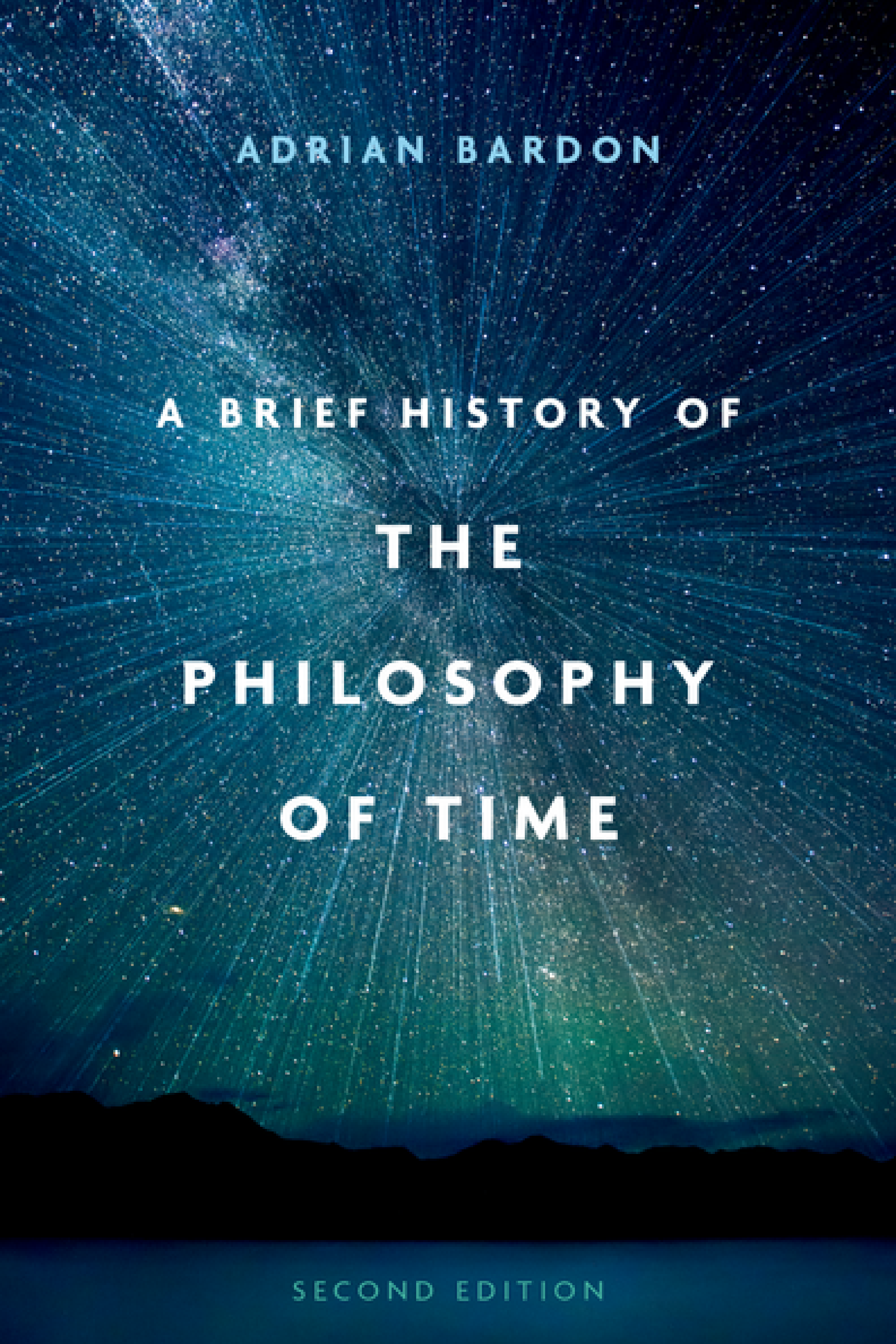

ADRIAN BARDON

A BRIEF HISTORY OF THE PHILOSOPHY OF TIME

SECOND EDITION

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Second Edition

Adrian Bardon

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For Janna, Zev, and Max

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Introduction

What Does It Mean to Ask, "What Is Time?"

It's not so easy to specify just what you are asking when you are asking, "What is time?" In ordinary discourse, we employ temporal terms like "past", "present", and "future" without thinking much about what they mean. In describing the natural world, scientists tend to presume an understanding of temporal concepts like duration, succession, or the earlier-later relation. To formulate sensible questions about time we need to look at the temporal concepts we take for granted in both colloquial and scientific discourse.

There are two essential characteristics about reality that most will agree on. First, things that happen are arrayed in a sort of order where what is happening depends on where we are in that order. Second, the world changes as states of affairs come to be or pass away. (Roughly speaking, we use calendars to track this first aspect of reality and clocks for the second.)

We can measure time with a clock. This doesn't tell us much by itself: What clocks measure is duration, and duration is itself a temporal concept. Clocks don't make sense unless we already know what they measure. We also think of time as a kind of venue for things that happen; we can locate these happenings on a calendar.

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In this way we locate events in time, but not in the way things are located in space. (What does it mean for something to be 'in' time?) Time seems to have something to do with change. Again, this is just a starting point, because it's tough to see how we could understand what change is without already understanding what time is: Change involves something having different properties at different *times*. We also speak of change 'of' time: The future, we sometimes say, approaches, and the past recedes. But is this supposed to be a real phenomenon or just a metaphor of some sort?

The nature of time has been a core subject for scholars since the earliest times we know scholarship even existed. Time is a demanding area of study because questions about time tend to be questions of the tricky, philosophical sort. Here is an example of a distinctively philosophical inquiry: the ontological status of mathematical objects like numbers. Asking, "Do numbers exist?" is a fundamentally different enterprise from asking whether, say, three-toed sloths exist. We know what the latter question means. We know what would constitute success or failure in finding three-toed sloths: Either we find some or, after a careful and thorough search, we don't. Asking whether numbers really exist is a whole different enterprise. It's not something we uncover just by looking around; it's more a matter of generating the most reasonable position on their existence given what we do know.

Consider another classic preoccupation of philosophy: moral facts. Upon examination, a murder scene may reveal a body, a bloody knife, even fingerprints. But the moral viciousness of the act of murder, no matter how closely we look, is not something we actually see in addition to these other elements. Moral facts, such as the fact that murder is wrong, are things we like to think we can know; but it is awfully tricky to explain just what sort of facts they are and how it is we know them.

Take visual color as yet another example. We know that the color of things can vary according to the observer as well as the lighting conditions. So, do things have a true color or not? Is color a real property of objects at all? These are philosophical questions about color. Note the relationship between these questions and a scientific understanding of color. Philosophical inquiry into color raises questions about how best to think about what we have learned from the science of perception. These questions begin with the scientific description of the situation: Objects reflect light at a certain wavelength, and our brains are organized such that they register corresponding visual sensations in predictable ways. The philosophical discussion uncovers the relationship between the basic scientific picture and more abstract questions like "What is it for something to be a property of an object?" And "Where do we draw the line between subjective experience and objective reality?"

These examples may help us understand why we find a discussion of the nature of time so challenging. The question as to whether time is real is more like the question as to whether numbers, moral facts, or colors are real than the question as to whether sloths are real. We have a science of time and a science of time consciousness, but the meaning of these sciences needs examination and analysis. Basic concepts need to be clarified; undefended assumptions need to be investigated. Happily, these are things that philosophers are especially good at.

What is the relation between time and change? Why do we remember the past and not the future? Is the passage of time real or just an aspect of our consciousness of events? What explains the direction of time? Is time travel possible? Do our choices change the future, or is the future already written? Philosophers have been working on these questions for several thousand years; that's good news for us, because this means a lot of the groundwork has already

been done. Over the centuries, theories about the nature of time have resolved into three main categories: realism, idealism, and relationism. Realists maintain that time is a kind of underlying matrix for events, but with an existence distinct from the events themselves. Idealists believe that time is an entirely mind-dependent phenomenon—a mere artifact of human consciousness. Relationists take something of a middle path: They argue that time is just a way of describing change, but the changes it describes are real.

Scholars in ancient Greece were divided over these three basic views about time. It is with this early dispute that we begin.

Chapter 1

Time and Change

We measure weight with a scale and temperature with a thermometer. When we measure time—say, with a clock—what is it that we measure? To some thinkers in the ancient world, the answer was that time is simply the measure of change. What is real is a changing universe; time is a conceptual scheme that describes motion and other changes. The leading proponent of this view was the celebrated Greek philosopher Aristotle of Stagira. His key philosophical opponent on this issue was Parmenides of Elea, who denied the reality of change—and thus denied the reality of time as well.

THE ELEATICS

There was a remarkably high level of scholarly activity among the ancient peoples of the Mediterranean region—particularly in Greece and numerous Greek colonies—around twenty-five hundred years ago. Persia and India were also significant players in ancient Greek scholarship, with contact between the traditions dating back at least to the sixth century BCE (and almost certainly far

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earlier). In addition to areas of study ranging from mathematics to politics, various regions supported distinct schools of metaphysics (meaning scholarly traditions specializing in the philosophical investigation of the nature of reality itself). One approach that many of these schools had in common was a certain emphasis on the divide between appearance and reality. One such influential school of thought—known as the "Eleatic" school because its proponents came from the Greek colony of Elea on the Italian coast—argued that motion and change are not just unreal but impossible. As (they would also maintain) there is no time without change, their denial of the reality of change is also a denial of the reality of time. As odd as it may sound to propose that there is no such thing as time and change, this theory's proponents had some surprisingly compelling things to say in favor of this thesis.

The Eleatic school of thought included two of the greatest early philosophers of nature, Parmenides and Zeno. We think that Parmenides was born around 515 BCE and lived to be at least sixty-five years old. Zeno, his student and ally, was about twenty-five years younger. The only records we have of their work are snippets quoted or discussed in the writings of other ancient and medieval scholars. In their time, though, they were very well known. Their view of reality stood in opposition to that of their contemporary Heraclitus of Ephesus, who argued that reality is characterized by unending change, with nothing constant in the world. Heraclitus claimed that our awareness is always changing; what we experience is always undergoing change—even if we don't realize it, as when we identify a river as the same river even though the water making up the flowing river is constantly replaced. The Eleatic school, in contrast, centered on one tenet that might seem radical: that all change is an illusion—that, in truth, all the world is an unchanging, timeless

unity. In philosophical terms, then, they were temporal **idealists**: Time is merely a kind of idea in the mind, rather than a process that can genuinely be attributed to nature. What could be said in favor of such a counterintuitive notion? Quite a bit, as it turns out.

ZENO'S PARADOXES

The Eleatic rejection of the reality of change is the point of Zeno's famous paradoxes of motion. Zeno came up with an unknown total number of these; they were variously critiqued by a number of ancient scholars, particularly Aristotle. The three paradoxes most often discussed, and most closely related to Parmenides's shared views about change, are known as "The Dichotomy", "Achilles and the Tortoise", and "The Arrow."

1. The Dichotomy

Suppose someone (call her Atalanta) intends to walk at a steady pace to the grocery store down the block. To arrive at the store, Atalanta must first cover half the distance to the store. This leaves her with a certain distance yet to cover. To reach the store from there, she must again cover half the remaining distance (i.e., one-quarter of the total distance). Having accomplished this, she must cover half the remaining distance (i.e., one-eighth the total), and so on. This means that Atalanta, to reach the store, must cover an infinite number of finite distances (see figure 1.1). This she could not possibly do in a finite amount of time. Therefore she can never arrive at the store. Of course, people successfully reach their destinations all the time; thus the paradox.

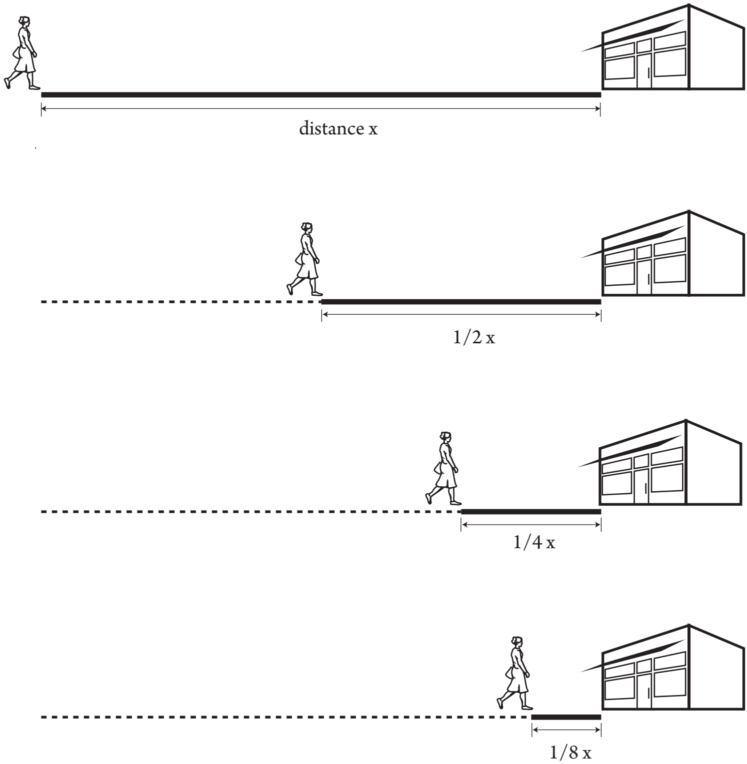

Figure 1.1. And so on, ad infinitum. It seems that Atalanta has an infinite number of finite distances to traverse before she can reach the store.

2. Achilles and the Tortoise

Zeno's second paradox of motion makes a point similar to the first. He imagines epic anti-hero Achilles—apparently known for his foot speed until his unfortunate heel injury—racing against a much slower tortoise. Suppose Achilles gives the tortoise a head start. For Achilles to catch up to the tortoise, he must first reach the

point (call it point A) where the tortoise was when Achilles started running. By the time Achilles gets to point A, the tortoise will have moved forward to a farther point (B) and will still be progressing slowly away. To catch up to the tortoise, Achilles must first get to point B. Then the same for point C, and so on. Similarly to the first paradox, it appears that catching the tortoise will take an infinite number of stages of travel—a series of stages that will have no end—each of which will require a finite (albeit ever-diminishing) amount of time to accomplish. Could such a series of tasks ever be completed?

3. The Arrow

Zeno's third paradox makes quite a different kind of argument. Take an arrow flying through the air. Is it really in motion? It can't be, according to Zeno, for the following reason: Whether or not something is in motion should be a fact about that thing *now*, not a fact about it in the past (i.e., that it was somewhere else) or a fact about it in the future (i.e., that it will be somewhere else). But at any given instant, the arrow only occupies a space equal to its own size; and when something occupies only a space equal to its own size, it is at rest. Therefore the arrow cannot be in motion at any time. Because the same reasoning would apply to any object in motion, motion is impossible.

Zeno concludes that, even though it appears for all the world as if things move and change, reason and logic rule out the possibility of motion. His resolution of this paradox is that movement, and change in general, is an illusion. The true nature of the world (i.e., its unchanging perfection) is revealed to us when we dismiss our fallible sense experience and rely on reason alone.

ARISTOTLE'S ANSWER TO ZENO

We know about Zeno's paradoxes mainly through Aristotle, who resisted the Eleatic attack on the reality of change. He actually agreed with the Eleatics in rejecting the idea that time is real in itself. Nevertheless he maintained that change is real: Objects move from one place to another, seasons change, ice melts, and so on. Aristotle saw a relationship between change and time, but the nature of that relationship requires some explanation.

Zeno and the Eleatics may have been responding to a tradition of temporal **realism** deriving from the ancient Indian Nyāya school (later associated with Hinduism), active since the sixth century BCE. As philosopher Anindita Balslev explains, the Nyāya school held that all contingent existence depends on its participation in time, whereas absolute time itself is fundamental as the venue for all events and incidental existents. By extension, change and movement, under a realist framework, must involve changes in relation to time; thus each part of a movement requires a moment of time at which it occurs, with later parts of the movement occurring at a different time. Despite their differences, Zeno and Aristotle each would reject this view describing time as the real, underlying venue for change and motion.

Aristotle's teacher, the famous Plato of Athens, had expressed sympathy for a different form of realism about time. This unique but opaque doctrine is examined by philosopher Louise Robinson Heath in her 1936 book *The Concept of Time*. As Heath explains, for Plato, time is measurable and quantifiable only because it is "embodied in concrete events". In Plato's dialogue *Timaeus,* the character of Timaeus identifies time with the motion of the heavens (i.e., the sun, the moon, the planets and stars). Timaeus goes on to claim that time would

come to an end if these bodies would cease their orbits. (Unlike in the Nyāyan tradition, then, Plato's time, while real, is not absolute and independent but contingent on a particular movement—the movement of the heavens.) Time is related to change in the sense of being directly identified with a specific set of motions. In the dialogue, Plato describes this story as a "likely account" of time. Aristotle finds this realist doctrine unpalatable, pointing out that, even if the heavenly bodies stopped dead in their tracks, time would still be passing as long as some other things were in motion.

Nor should we simply identify time with motion or change in general, Aristotle continues. He notes that change is a contingent and local phenomenon, whereas we think of time as passing equally for everything everywhere, no matter what is going on in the immediate vicinity. Further, although changes can be slow or fast, time cannot; "slow" and "fast" are defined in terms of time, not vice versa. So time cannot literally be change.

Rather, for Aristotle, the relationship between change and time is not one of identity, but more like the relationship between the thing measured and the means of measuring it. Time is not a process: It is just a kind of unit system that can be used to describe processes in nature, analogous to the way numbers can be used to count things. In his words, "time is the number of change with respect to before and after." As with other unit systems, time is a kind of system of measurement that captures something real about nature without itself being part of nature. If you see three goats, there isn't really any 'threeness' *out there* in addition to the goats; but that is not to say that there aren't really three of them. We can truly say that the sun is brighter than the moon, and that an elephant is bigger than a mouse, even though 'brighter' and 'bigger', as mere relations, aren't really things in the world like suns, moons, elephants, and mice. In the

same way, we can say that a performance of Shakespeare's *Hamlet* really lasts two hours longer than a TV cartoon show, even though there are no hours out there to count. What we do is use regular motions, like the orbit of the earth or moon, or the ticking of a clock (in Aristotle's time, more likely the dripping of a water clock), as units of duration, which in turn can be used to count, order, or measure other durations, motions, or changes. Time as a system of measurement would not exist without consciousness, but what it describes—movement and change—do exist. Time itself thus exists only in the sense that it is a unit system used to count, order, or measure such processes. As Aristotle puts it, "to be in existence while time is in existence does not constitute being 'in time.'" Yet we can still make perfectly reasonable statements about the duration of events. This is not the temporal realism Zeno was critiquing. Aristotle's view about time is neither idealism nor realism; rather, it is a version of temporal **relationism**, in that it treats time as a way of thinking about how events can be objectively related to each other.[1]

Aristotle's theory allows an answer to Zeno that preserves change as a genuine aspect of reality. He thinks that Zeno's paradoxes rest on a confusion between time and what it measures. For Aristotle, time is a unit of measurement used to describe changes; as such, time is a quantity that belongs to the mathematical rather than the material realm. Zeno's paradoxes are dissolved by the realization that concepts like extension, divisibility, and composition work differently when you are talking about (merely) mathematical quantities

1. Aristotle's temporal relationism is quite reminiscent of the doctrines of the Indian Sankyha school, the origins of which may go back as far as the eighth century BCE. According to this tradition, the change and movement of transcendent nature (or "prakriti") is fundamental, with time only an aspect of it. Just as in Aristotle, it makes no sense to speak of time independently of the concept of change. More recently, the famous early twentieth-century astronomer Arthur Eddington identified "time" simply as a term for describing measurable relations between events.

in a stipulated mathematical realm. Consider the paradoxes of "The Dichotomy" and "Achilles and the Tortoise". On Aristotle's conception, time is like the number line, in that any segment of the number line is, potentially, infinitely divisible. You can take the interval between, say, the integers two and three and divide it in half, then in quarters, then in eighths, and so on indefinitely. As Aristotle points out, although you can identify infinitely many distinct points between the numbers two and three (corresponding to each possible division of that segment of the number line), and infinitely many distinct points within any subdivision of that distance, the distance between two and three is not (and couldn't be) *composed* of those points in the way material objects are composed of atoms. The stipulated rules for an abstract mathematical realm shouldn't be confused with the actual rules for physical reality. Euclidean objects like squares and right triangles are abstract mathematical objects; they do not and cannot exist in reality. A point in Euclidean geometry has zero length, and no number of things with zero length can be added together to form something of finite length. Geometrical points are just abstract boundaries on merely potential subdivisions. Things work similarly, Aristotle argues, for instants in time. A length of time—say, the time it takes to walk to the grocery store—is not actually composed of an infinite number of smaller, finite lengths of time. Zeno's first two paradoxes of motion rest on supposing that the time it takes to get from one place to another is actually composed of an infinite number of finite lengths of time; if it were, then he would be right that any motion from one place to another would require the completion of an infinite number of distinct tasks. Aristotle concludes that these alleged paradoxes rest on confusing time (= an abstract unit system) with change (= a real phenomenon that can be measured in terms of time units). The existence of these

false paradoxes, Aristotle would like to say, just goes to show that he has the right analysis of time.

Has Aristotle thus solved the problem posed by Zeno's first two paradoxes? Some have claimed that Zeno's challenge was only really answered with some new mathematical ideas in the nineteenth century. Contemporary mathematics adds a concept that, if permitted to describe change itself, would more directly resolve the paradoxes. The concept of a **limit** allows for an infinite number of finite quantities to add up to a finite sum. In the relatively modern branch of mathematics known as calculus, the sum of ($\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} \ldots$) is said to approach, or converge on, the value 1. This quantity is the "limit" of that particular process of addition. (In contrast, the sum of the non-converging series [$1 + 2 + 3 + 4 \ \ldots$] has no limit.) Is this the solution to Zeno's challenge? If we were to accept that completing a physical motion is like reaching a limit, then Atalanta and Achilles wouldn't need to accomplish the impossible in order to finish their tasks. In one respect, this distinction meshes nicely with Aristotle's assertion that the "potential" infinity in question in "The Dichotomy" and "Achilles and the Tortoise" paradoxes is not to be confused with an "actual", extensional infinity. But where Aristotle's solution was to avoid contradiction by distinguishing between the rules for change (as a real phenomenon) and those for time (as a mere abstraction), the notion of a limit gives us the resources to describe, without contradiction, a finite magnitude as actually divisible into an infinity of finite sequences. In other words, this answer doesn't depend on drawing a line between change-the-reality and time-the-abstraction the way Aristotle's does. However, this use of the mathematical concept of a limit allegedly functions as a solution by simply stipulating that a converging series actually converges. By definition, a limit can't be a real endpoint to a real process. It is just an abstract mathematical convention; to offer this concept as

a solution really is to concede the exact question about time and change Zeno and Aristotle are struggling with. Does it really help matters to say that Atalanta's progress to the store represents convergence on a limit? That wouldn't have sounded like real motion to either Zeno *or* Aristotle. By contrast, Aristotle's relationism has the virtue of not forcing real-world actors to perform weird mathematical tricks.

Although Zeno's paradox of "The Arrow" appears to be making a different argument, Aristotle's answer to it rests on the same fundamental point: namely, that the Arrow paradox depends on the false premise that, if time is not a mere illusion, it must therefore be actually composed of instants. Zeno presumes that something in motion can only be in motion by virtue of its state at that instant. Aristotle would prefer to say that motion is motion over an interval with nonzero duration; that is why we describe motion in terms like "miles per hour" or "meters per second". By definition, an instant per se has zero duration, and so the idea of motion over an instant is incoherent: Distance traveled per zero seconds is not a rate of motion. Similarly for the notion of rest at an instant: By Zeno's reasoning, to say that something is at rest at an instant is to say that it moved zero meters in zero seconds. This description of rest doesn't make any sense either; rather, we should say that something at rest is moving zero meters *per second*. As with the other paradoxes, Aristotle's diagnosis is of a false paradox resting on the confusion of (a) an abstract value (i.e., time), which is mathematically divisible into instants, with (b) actual change, which is not literally composed of infinitesimal units of change.

The strongest virtue of Aristotle's theory is that it quickly dissolves these counterintuitive paradoxes. Further, note that he has replied to Zeno on the Eleatics' own terms: via reason alone. In most cases, when we want to say the world is a certain way and

not otherwise, we tend to think that the best way to accomplish this is by observation and experiment. But the Eleatics' whole worldview is based on the notion that sense experience is fundamentally unreliable. Aristotle realizes that, in replying to them, it would be question-begging to rely on observation and evidence; rather, his analysis of time rests solely on *reasoning* about time and change, and so it is not open to any reply by Zeno that Aristotle has mistakenly assumed that we can rely on the evidence of our senses in understanding nature.

PARMENIDEAN IDEALISM

Aristotle didn't have too much trouble dispensing with Zeno's paradoxes. His argument against Parmenides, Zeno's mentor and fellow temporal idealist, is another story. Parmenides had offered a different argument altogether for the thesis that change is a fiction. Sometime in the fifth century BCE, he wrote a lengthy prose poem (existing for us only in tantalizing fragments) in which he presented a line of reasoning discounting the possibility of change—a line of reasoning that is, incidentally, particularly interesting because it is thought to constitute the world's earliest surviving example of extended philosophical argumentation:

> As yet a single tale of a way
> remains, that it is; and along this path markers are there
> very many, that *What Is* is ungenerated and deathless,
> whole and uniform, and still and perfect;
> but not ever was it, nor yet will it be, since it is now together entire,
> single, continuous; for what birth will you seek of it?

> How, whence increased? From not being I shall not allow
> you to say or to think: for not to be said and not to be thought
> is it that it is not. And indeed what need could have aroused it
> later rather than before, beginning from nothing, to grow?
> Thus it must either be altogether or not at all.
> Nor ever from not being will the force of conviction allow
> something to come to be beyond it: on account of this neither to be born
> nor to die has Justice allowed it, having loosed its bonds,
> but she holds it fast. And the decision about these matters lies in this:
> it is or it is not; but it has in fact been decided, just as is necessary,
> to leave the one unthought and nameless (for no true way is it), and <it has been decided> that the one that it is indeed is genuine.
> And how could *What Is* be hereafter? And how might it have been?
> For if it was, it is not, nor if ever it is going to be:
> thus generation is extinguished and destruction unheard of. (Palmer, trans.)

There are several distinct points being made in this fascinating piece of text. For Parmenides, the thought of change is the thought of something becoming something else, which necessarily involves the thought of some thing (or state of a thing, like the fading color of a rose) going from being future, to being present, to being past. The thought of change, then, is bound up with the thought of the passage of time from future to present, and present to past. It is common to

say that something "awaits us in the future" or "lies in our past". This is to treat the future and past as though they are real, the way other places are real even though you are not there to see them. However, in our ordinary way of thinking about time the past and the future are contrasted with the present, in that the present is thought of as real while the past and future are not: If something is real, then it is real *now*. If future and past events were real now, then they would be present! So to think of what is past or future is to think of what *is not*. ["And how could *What Is* be hereafter? And how might it have been? For if it was, it is not, nor if ever it is going to be."] Thus Parmenides' conclusion that we contradict ourselves when we describe the world temporally: Any talk about change involves talking about the past or future as real *and* as not real.

To this he adds that our nonsensical talk about change gets us into strange habits and beliefs, like talking about a non-present object—which is really nothing—as though it is something ["for not to be said and not to be thought is it that it is not"]. Also, by being committed to change, we are effectively saying you can get something from nothing: Because the future is nothing, the coming about of any event is a case of something coming from nothing. But nothing could explain the existence and characteristics of a thing arising from, literally, nothing, and nothing could explain why it would arise then, as opposed to at some other moment ["what need could have aroused it later rather than before, beginning from nothing, to grow?"]. The notion of real change would also suggest that things can pass out of present existence. But where would they go? To the past? Where is that? If something exists in the past, then it exists. But if something exists, it is present. It doesn't make any sense. Things either exist or they don't.

One could reply that there is another dimension to time independent of change. What about some object, like a stationary rock,

or a chair, that just exists for a while, unchanged? Even as we concede that there is no change, wouldn't there still be the time that passes as a thing *endures*? Parmenides anticipates this objection. He replies that an enduring object would have to have temporal parts: parts that exist now, plus parts that did exist but don't now, and parts that only will exist. But then the object would, once again, both exist and not exist. How can an existing thing have non-existing parts? The persistence of an object over time suggests that part of it must be past and part present; yet also, if an unbroken armchair exists right now, then presumably it exists in its entirety right now ["but not ever was it, nor yet will it be, since it is now together entire"]. So the idea of duration is just as incoherent as the idea of change.

For Parmenides, the moral of this story is that the very notions of change, duration, and the passage of time are self-contradictory, and so the world of time and change as it appears to us cannot be real. This was what the Eleatic school was all about: the view that the world as we know it, consisting in a constantly shifting array of impermanent objects and their relations and characteristics, is a matter of mere subjective appearance. Another fragment from the poem:

> . . . for nothing else <either> is or will be
> besides *What Is,* since it was just this that Fate did shackle
> to be whole and changeless; wherefore it has been named all
> things
> that mortals have established, trusting them to be true,
> to come to be and to perish, to be and not to be,
> and to shift place and exchange bright color. (Gallop, trans.)

Insofar as sensation leads us to accept the reality of change, our senses are fundamentally deceptive. Our experience of motion, change, and the passage of time is a projection of our own limited

perspective on reality. 'Time talk' is really incoherent, a fact hidden by our facility with the use of tenses and other temporal language. We see this, Parmenides would say, when we step back from what our senses and instincts are telling us and reason coldly about whether our assumptions really make sense. The world as it is in itself can only be the "What Is": a unitary, unchanging, perfect singularity.[2]

Parmenides's argument for temporal idealism is strikingly similar to what we find in the ancient Indian school known as the Advaita Vedanta, considered the culmination of the important Upanishadic tradition. The Advaita Vedanta argues that time only exists if "past", "present", and "future" are substantive designations for events; but there is no non-circular or logically consistent way to attach such designations to events (again, see Anindita Balslev for a thorough analysis of this system of thought). The conclusion is that reality ("Brahman") is unitary and timeless—much like the unitary and timeless "What Is" of Parmenides.

As extreme as its conclusions are, the temporal idealist worldview should not be dismissed too easily. What guarantee do we have that sense experience provides an accurate picture of how the world is? It is true that we would expect that our senses would have evolved such that we are able to interact with the world around us in a survival-enhancing way, and in turn this would seem to imply that our belief-forming faculties tend to be reliable; after all, we would have a tough time negotiating our environment if our beliefs about our surroundings were frequently false. But it is not at all clear that the knowledge necessary for survival (like what plants to eat or where to find water) would also include knowledge of the true, underlying nature of the world itself. The beliefs we need from a

2. This might sound like a mystical or religious position, except for the fact that the Eleatics rely for their conclusions on reason and logic, rather than on faith or mysticism.

survival standpoint mostly have to do with predicting what we will experience given what we are experiencing now. It would be possible to be very successful at such predictions while still being quite in the dark as to whether the ways in which we categorize our experiences accurately reflect reality. In the absence of more sophisticated calculations, nothing could be more natural than to think the sun orbits the earth; and thinking this wouldn't cause us any problems in our day-to-day efforts to survive and reproduce. Tomatoes are nutritious even if we believe they are vegetables; water is healthful and refreshing even if we deny it to be made up of H_2O, or lack a notion of molecules entirely. It would make sense for us to instinctively fear all snakes and spiders, even if only some types are dangerous. Similarly, the fact that thinking in terms of change works for us doesn't necessarily mean things really change. Maybe representing things temporally is just our way of functionally modeling the world as best we can given a limited perspective, a bit like the way a painter uses two-dimensional surface patterns to suggest a three-dimensional landscape.

Aristotle has a partial answer to Parmenides, but it is obviously incomplete. Aristotle agrees with the assertion that our use of "now" or "the present" to refer to more than an instant (as in "the present day", for example) is problematic from a metaphysical point of view; at any given moment, part of our day would be past and part of it would be future. Taking such loose temporal talk seriously would get us into one of the contradictions Parmenides exploits in his argument. Aristotle, much like pre-Socratic predecessors Empedocles, Anaxagoras, and Democritus, thinks he can resolve this particular problem by distinguishing between different kinds of change. His answer focuses on the claim that no existence can emerge from nonexistence. To this concern, Aristotle replies that change is not the emergence of something from nothing. All we

have to do is to distinguish between the thing that changes and its configuration, properties, or aspects; the latter are what do the changing. If a person blushes or pales, the person him- or herself does not come into being from nothing; rather, there is a persistent thing—the person—with variable attributes. So the person can be both pale and not pale without him- or herself both being and not being. It is also true that persons can come into being, but only, Aristotle would argue, by a reshaping of an existing underlying substance, just as molten bronze can be formed into a statue. The statue is not thereby created from nothing, and the statue does not become nothing if melted down.

With this response, however, Aristotle has not really addressed Parmenides' main point. The really central issue was whether, when we describe change of any sort (including Aristotle's change in properties), we commit ourselves to the reality of the future from which the new situation arises, and/or the reality of a past to which it passes. But the future and past can't be real, because then what would distinguish them from the present? If the future and past are not real, then no state of things can pass from being future to being present to being past. If there is no passage, then there is no change. If there is no change, then there is no time. *That* was Parmenides' fundamental problem with change and the passage of time, and Aristotle didn't say anything to dispel this worry.

Consequently, although Aristotle's relationism may help with Zeno's paradoxes, it does not really address the main Parmenidean argument. Temporal idealism was revisited centuries later by Augustine of Hippo. Augustine (aka Saint Augustine, the fifth-century Catholic bishop), was a North African of Berber descent. He was a careful and insightful philosopher, as well as the most important early Christian theologian. He wrote an enormous number of books, but is best known for his *Confessions*, which combines

an account of his conversion to Christianity with some very sophisticated philosophical investigations into time, memory, and cosmology.

AUGUSTINE'S THEOLOGICAL IDEALISM

Augustine was well aware of the ancient debate over the reality of time. Augustine's primary interest in time had a theological basis. He was worried about questions like "What was God doing before creating the universe?" and "If nothing existed (but God) before the universe was created, then why create it at one time rather than another?" This last question particularly troubled Augustine: If nothing existed but God before creation, then what could have happened to, or within, God that made Him decide to create the universe at that particular moment? The new impulse that would have to have arisen at that moment suggests a *change* for God; but why would an eternal and perfect being want or need to change?

Augustine's answer is to embrace a revised set of arguments for idealism about time and change: Like Parmenides, he argues that time and change are mind dependent.

Augustine's preliminary goal is to call our pre-critical grasp of time into question. He famously asks: "What, then, is time? I know well enough what it is, provided no one asks me. But if I am asked what it is and try to explain, I do not know." He offers the following line of reasoning:

> Of these three divisions of time [past, present, and future] then, how can two, the past and the future, *be*, when the past no longer is and the future is not yet? As for the present, if it were always present and never moved on to become the past, it would not be

> time but eternity. If, therefore, the present is time only because it moves on to become the past, how can we say that even the present *is,* when the reason why it *is* is that it is not to be? (Pine-Coffin, trans.)

So, similarly to Parmenides, the past and the future *are not* (now), so they are not real. Further, the present is ad infinitum analyzable into smaller and smaller durations: We can speak of the present day, but part of that day is past (and so nonexistent) and part is future (and so also nonexistent). Same for the present hour, the present minute, and so on. Any time you pick out includes times that are not present; there doesn't seem to be an actual, identifiable present *time*.

Yet, Augustine continues, we are aware of extended periods of time; we can compare periods of time to each other; and we are able to compare the present situation to the way things were in the past:

> Nevertheless we do measure time. We cannot measure it if it is not yet in being, or if it is no longer in being, or if it has no duration, or if it has no beginning and no end. Therefore we measure neither the future nor the past nor the present nor time that is passing. Yet we do measure time.

How is our awareness of time possible, if there really is no past, present, or future for us to be aware of? This is a key question for the temporal idealist. Augustine's answer is that time exists only in the mind. Memory, sensation, and anticipation leave impressions on us, and it is these that are measured and compared when we make judgments about the passage of time. Nothing outside the mind really persists; rather, "the mind's attention persists". Memory and anticipation give our experience its temporal dimension, not the veridical perception of something outside the mind actually enduring

and undergoing changes. The difference between past and future is just the difference between memory and anticipation.

Time, then, for Augustine is a human invention, and the concept of time is applicable neither to the real world nor to God—who exists instead in a kind of Parmenidean timeless state that Augustine calls "eternity". (This general approach, contrasting a non-temporal eternity with a mind-dependent human time, is echoed by many later scholars—for example, the great Jewish philosopher Baruch Spinoza.) This analysis solves Augustine's theological problem, because questions about what God was doing before the universe was created, or why God would decide to create the universe at one time rather than another, are moot if the passage of time does not apply to God.

So Augustine, motivated by the desire to invalidate certain tricky theological questions, invokes a variation on Parmenidean temporal idealism as the solution. In the process, he raises some good questions about how we come to make judgments about the passage of time and the duration of events. Augustine did not seem to realize, however, that his treatment of these questions raises a very difficult issue for the temporal idealist: How do we even come to have the *concept* of the past, the present, the future, and the passage of time if we never actually experience them? Even if these judgments are false, they involve ideas that must have come from somewhere. Augustine presumes the capacity to employ temporal concepts without explaining where those concepts come from in the first place. He talks about memory and anticipation, and how they create a kind of metaphorical 'extension' of the mind (that we then confuse with objective temporal extension). But a memory is, by definition, a representation of the past *as past*. What gives memory the meaning it has for us? How do we recognize a memory as a reproduction of a past experience, as opposed to a product of

present sensation, without knowing what it means for something to be in the past? Parmenides and Augustine agree that the past does not exist, so we never actually experience the past. Neither do we experience the future. If time does not exist, then where do our concepts of the past, or the future, or the passage of time, come from? In the next chapter, we examine a few different ways to answer that question.

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Chapter 2

Idealism and Experience

We ended the last chapter wondering where the very *idea* of time comes from, given that (a) we could never experience past or future events directly, and (b) memory and anticipation only have the meaning for us that they do because we already understand their connection to the past and future. Clearly, we have no problem understanding what it means to remember or anticipate. But how we originally generate the idea of time is a different story. In the last chapter, we saw that the question as to whether change is real was the focus in the ancient world; in the European Enlightenment era of the seventeenth and eighteenth centuries, the question as to the origin of temporal concepts became a central concern in its own right.

LOCKE'S MISTAKE

The English philosopher John Locke is probably best known for his 1690 *Second Treatise of Civil Government*; this was an important early treatment of the notion of government by social contract. But he also studied the human mind—a study that, for him, was intimately tied up with his interest in political liberty. European history for the previous thousand years and more had been characterized by claims

A Brief History of the Philosophy of Time. Second Edition. Adrian Bardon, Oxford University Press.
 DOI: 10.1093/oso/

by a few—whether kings or religious leaders—to have privileged access to the truth; such claims were the basis for dogmas that could be exploited in consolidating power. In response, Locke spent many years working on a massive examination of human ideas, language, and knowledge titled *An Essay Concerning Human Understanding*. His main goal in this work was to show that all human knowledge is ultimately derived from nothing more than experience. This is a doctrine known as **empiricism**. The empiricist believes the human mind begins as a blank slate that is eventually filled with ideas derived only from sense experience and reflection on that experience. The connection between empiricism and liberty, for Locke, is that empiricism as a theory of knowledge contradicts claims by religious or civil authorities that they have special access to fundamental truths that are inherently unavailable to everyone else.

As a key part of this program, Locke spends several hundred pages trying to explain how even complex and abstract ideas are ultimately derived from sense experience. He devotes a chapter to explaining the origin of the ideas of succession, duration, and eternity. Locke was not an idealist about time: He was a temporal realist who thought that time and space were real, independent entities in their own right (Locke's views on time were influenced by temporal realist Isaac Newton; see chapter 3). As is standard for the realist, Locke thought that objects and events are *in* time; their existence is dependent on their actual participation in an objective, unique, but changing present moment.

But Locke recognized that, even on the realist view, time is not an actual object of experience—it can't be felt or seen or otherwise directly observed. So he sets out to explain how we get the idea of time from experience alone nonetheless. Here is what he has to say about the origin of the ideas of temporal succession and duration:

> ’Tis evident to anyone who will but observe what passes in his own mind, that there is a train of ideas, which constantly succeed one another in his understanding, as long as he is awake. Reflection on these appearances of several ideas one after another in our minds, is that which furnishes us with the idea of *succession*; and the distance between any parts of that succession, or between the appearance of any two ideas in our mind, is that we call *duration*.

By a “train of ideas”, Locke is just referring to any sequence of ordinary thoughts and perceptions. I see my bus coming; then I notice that my nose itches; then I scratch my nose; then I think about whether I will be late for work. His proposal is that we originally get the notion of temporal succession simply by reflecting upon sequences of perceptions like these, either as they occur or afterward. Supposedly, this sort of reflection gives us a direct experience of succession.

It is important to see why this story is, at best, incomplete. Locke is claiming that the idea of succession derives from reflection upon a succession of ideas. But, at any given moment during the reflective experience of a succession of ideas, wouldn’t only one component of the succession—that is, the present component—be before the mind’s eye? If so, then reflecting on a whole train of ideas altogether would have to involve the reproduction, in memory, of past ideas or experiences. The mere reproduction of some past experiences could not by itself give rise to the idea of a succession: The individual components of a succession of ideas would have to be thought of as occurring at different times—otherwise, it wouldn’t be a *memory* of a succession of ideas, as opposed to a single, complex thought of a bunch of overlaid mental contents (see figure 2.1). Locke must be referring to a reflected-upon memory of previous

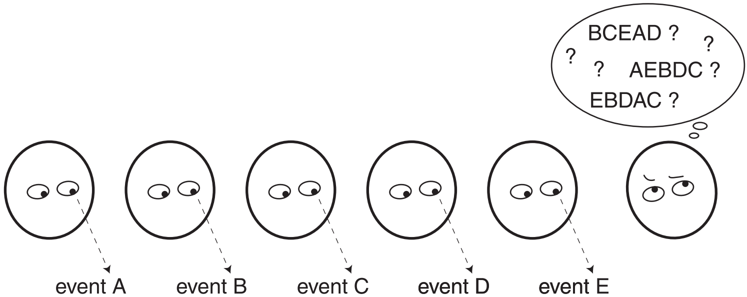

Figure 2.1. At the time of the reproduction of one's previous experiences, what reason does one have even to think of them *as* reproductions (much less to reproduce them in any particular order)?

elements of a sequence of experiences thereby identified *as such*—that is, as memories of past experiences instead of just things you are experiencing now. Thinking of a memory as a memory requires already identifying something *as past*; but without the idea of temporal succession already in place, the notion of 'pastness' couldn't mean anything to the experiencer. If one didn't know what it is for an event to succeed another in time, then one couldn't make sense of a present event becoming past by virtue of its being succeeded by another.

So we can see that Locke failed to explain how it is possible to recognize a succession of ideas or experiences as a temporal succession without presuming that one already grasps the concept of temporal succession. His 'blank slate' story about deriving the very idea of succession from experience can't work as it stands.[1]

1. There might be a story one could tell that would explain the possibility of a direct experience of succession (see the discussion of extensionalism later in this chapter), but Locke's account is not it.

KANTIAN IDEALISM AS A SOLUTION

The great eighteenth-century Prussian philosopher Immanuel Kant probably thought more, and more deeply, about time and our awareness thereof than anybody before or since. Kant was celebrated in his own lifetime for his study of knowledge, metaphysics, and the mind, as well as for work in moral and political philosophy, aesthetics, and many other subjects. His masterpiece was his *Critique of Pure Reason*, a massive and difficult work the main purpose of which was to address skeptical concerns about claims to scientific knowledge. His project was inspired by what he saw as the failure of Locke and other empiricists to account for the possibility of such knowledge. The physical sciences historically have revolved around key concepts like matter, causation, space, and time; much of modern science describes the world, at a fundamental level, in terms of these concepts. To be assured we are getting things right when describing the world using these concepts, we need to explain what entitles us to apply them to our experience. Kant recognized the shortcomings of empiricism in validating the scientific use of these foundational notions.

Kant's answer required a re-examination of the origin of abstract ideas (in particular, those foundational ideas of material substance, cause and effect, and time and space) and the justification of scientific generalizations about the world employing these ideas. This required launching an investigation into the basics of how the mind gets started in forming ideas about what is going on around it. Kant's insight was that the key to understanding cognition was an understanding of the most fundamental cognitive achievement—the one that makes all coherent experience possible: the interpretation of one's own experience in terms of time. He found that the

empiricist's problem with the origin of the idea of succession points the way to a solution: Time is a mere form of sensible experience, and the ordering of experiences in time derives from the mind's own imposition of order on experience. In short, temporal idealism is the answer to skepticism about the possibility of scientific knowledge.

Early on in his *Critique of Pure Reason*, Kant lays out his idealist position on space and time. He distinguishes between what we find in experience and the structure of experience itself. Space and time are not things in themselves, he says. Rather, they are mere "forms of experience": That is to say, we don't experience things in time and space so much as experience them *temporally* and *spatially*. Kant's key finding against Locke is that there is no way even to think about experience except temporally, just as there is no way to think about material objects except spatially. Locke has it backward when he proposes that the idea of time is derived from experience; rather, experience presupposes time.

Just like Parmenides and Augustine, Kant concluded that reality is itself atemporal.[2] Is such a thing (i.e., an atemporal reality) even thinkable? Yes and no, Kant would say. His theory explains imagination's inevitable failure in this regard: Because this way of experiencing things is an irreducible part of our sensibility, we literally can't imagine any other way for things to be. Yet we can intellectually come to terms with the ideality of time. In this way, the ideality of time is like the mathematical concept of infinity: We cannot imagine the infinite (we cannot call up a mental image of,

2. Kant has been criticized for concluding that reality is atemporal just on the basis of his position that our temporal concepts can't come from an experience of real temporal relations. Indeed, the latter doesn't by itself mean that there aren't any real temporal relations. He might reply that, given his understanding of what time is, it doesn't even make sense to think of time as a concept that is applicable to a reality considered in abstraction from the way in which we experience it.

say, an infinite number of apples), but we can understand it. Kant thinks that an atemporal reality is something we can grasp in the abstract, even if it can never mean anything to us in practical terms.

This is a summary of Kant's views on time, but we need more than this to fill out a positive account of time-awareness. It's not enough just to point out the deficiency in any empiricist approach to time. According to Kant, we can't make any sense out of our experience without first understanding it in terms of time. This means that the temporality of our experience cannot be inferred from experience. So, Kant wonders, how is any judgment that some event A was followed by some event B possible? His answer has to do with the concepts of *substance* and *cause*. These are concepts that are integral to the notion of a material world independent of one's mind, in that the idea of such a world is, at root, the idea of a system of material substances interconnected by causal relations. His basic idea is that ordering one's own experiences in time is a necessary condition of any coherent thought; and the only way to get started with ordering our experiences in time is by thinking in terms of their relation to things going on around us. Kant's predecessors assumed that we start with a flow of subjective experiences, already organized both spatially and temporally, and from that infer our way to a picture of what is going on around us. He turns this completely around: He argues that there is no basis for thinking of one's experience at any moment as representative of some determinate spatially and temporally organized sequence of events unless one's interpretation of experience is constrained by some general notions as to how the world works. We start with an innate idea (call it an instinct, if you like, or a biologically determined disposition) of how things are 'out there' and interpret our subjective perceptions accordingly. Making sense of one's own experiences, you might say, works from the outside in, not from the inside out.

Kant's story goes as follows: Just as space and time are just forms of sensibility, the concepts of substance and cause are just rules for organizing experiences in space and time. The idea of temporal succession is innately present in our cognitive makeup as a set of organizational principles. Thinking in terms of a succession of experiences depends on relating those experiences to successions of events outside us; and we can only do that because we already have a certain schema built in for interpreting our sensory inputs in these terms. The operating system for a computer mediates between the computer hardware and the specific programs that handle the inputs; without an operating system, the most powerful and sophisticated computer hardware is not able to process information or do anything at all. Part of our own innate information-processing scheme is that we interpret all our perceptions on the working assumption that we are dealing with a world of enduring items interconnected by causal relations. (Call this the concept of *objectivity* itself—i.e., a general idea of what it means for something to belong to a world of objects of possible experience). We are guided by this scheme into imposing a pattern on experience consistent with such a world; this pattern involves sequences of events occurring in accordance with causal rules. So this is how we come to have the idea of temporal succession: It is a pattern corresponding to the concept of objectivity itself that we ourselves impose on sense data to make it tell a coherent story.

In processing incoming perceptual data, one of the really fundamental things we have to do is distinguish between static states of affairs and dynamic events or processes. Consider two possible temporally extended experiences: the experience of walking around a house and the experience of seeing a ship leave a dock. The first involves a succession of experiences of an unchanging state of affairs; the second involves a succession of experiences of an ongoing

process of change (i.e., an experience of an actual succession of events). But in each case the component experiences present themselves successively (see figure 2.2).

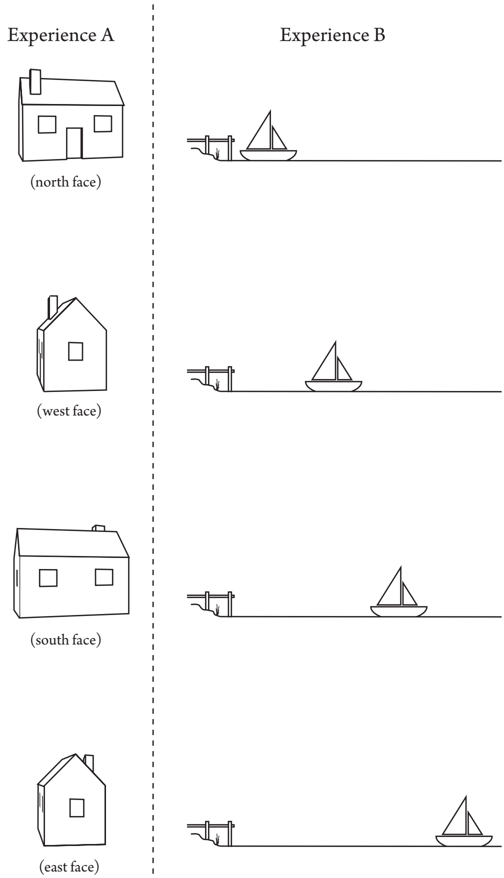

Figure 2.2. Each of these sets of experiences is constituted by a succession of perceptions, yet somehow we understand that one is the experience of an unchanging object and the other of an event in progress.

Strictly speaking, the contents of the experiences themselves don't provide prima facie evidence for one interpretation (i.e., static state of affairs or dynamic event?) over another—that is, not unless you already understand the difference between a static state of affairs and a sequence of events. So, how are we capable of this kind of distinction? Kant argues that the very notion of a difference between the two is coming from inside, so to speak: We are using one innate interpretive scheme in the one kind of case, and another scheme in the other. Of course, the distinction between the two kinds of experience seems obvious, but that is the point: This is not something we have to figure out from scratch. The concept of succession-according-to-a-rule functions as a template for organizing my experiences. I couldn't get this concept from experience (as Locke had claimed), because this ability is a necessary condition of my making *any* sense of my perceptual experience in the first place. Kant's conclusion is that the notion of rule-governed temporal succession must be innate and imposed by us on our own experience.

Kant's story is the most sophisticated idealist story so far. It has a certain plausibility in light of the difficulty empiricists have with explaining the origin of temporal concepts, insofar as time is not itself to be found in the contents of our experience. It bolsters the idealist case by accounting for the experience of succession (i.e., as made possible by an innate organizing principle of the mind) in the context of an inherently timeless reality. Kant also appreciates the fundamental importance of temporal organization to conscious experience; his account gains some credibility from the puzzle as to how we would be able to make sense of the white noise of incoming sensation without some starting point—a cipher key to unlock the code—and temporal organization does seem like a reasonable candidate as just such a starting point. The empiricist looks for time in

experience. Kant's idealist alternative would help explain why it is so hard to put one's finger on what time is when we look for it in experience. Kant accounts for the ineffability of time by explaining that we have been looking for it in the wrong place: We mistakenly look for time 'out in the world' when it is really a matter of how we organize our experience of the world.

It is important to note that Kant's theorizing falls far short of proof, even if, in principle, it solves a problem generated by a simplistic empiricist approach. There remain many questions one could raise for this theory, such as how and why one is constrained to interpret a subjective sequence of perceptions according to one schema rather than another, *if reality itself is not doing the constraining*. On an intuitive level, it just remains difficult to accept the idealist's contention that the universe is inherently atemporal (i.e., without us, things really do not change and time does not pass). Is there an alternative theory, compatible with realism about time, that offers a workable explanation of the origin of temporal concepts?

A REALISM-COMPATIBLE ALTERNATIVE?

Again, what the realist needs is an explanation of how the idea of temporal succession can be derived from experience alone.[3] American pragmatist William James was one of the founders of modern psychology. In his 1890 *The Principles of Psychology*, he argued that one's current perceptual state is not just a snapshot of the present instant, but rather directly encompasses a stretch of time—a **specious present**. The specious present forms part of my immediate experience

3. Some material in this section is adapted from my 2019 *Kant-Studien* essay, "Explaining Temporal Phenomenology: Hume's Extensionalism and Kant's Apriorism".

because the 'pastness' of some of the contents of my current state is somehow a felt aspect of my complex current state:

> To remember a thing as past, it is necessary that the notion of 'past' should be one of our 'ideas.' . . . But how do these things get *their* pastness? What is the *original* of our experience of pastness, from whence we get the meaning of the term? . . . [A]ll our concrete states of mind are representations of objects with some amount of complexity. Part of the complexity is the echo of the objects just past, and, in a less degree, perhaps, the foretaste of those just to arrive. Objects fade out of consciousness slowly. If the present thought is of A B C D E F G, the next one will be of B C D E F G H, and the one after that of C D E F G H I—the lingerings of the past dropping successively away, and the incomings of the future making up the loss. These lingerings of old objects, these incomings of new, are the germs of memory and expectation, the retrospective and the prospective sense of time.

The specious present proposal is that our experience at any moment encompasses both the present *and* the immediate past. If so, that means that we experience succession or change directly, without having to rely on inference or memory. The twentieth-century logician and philosopher Bertrand Russell was a supporter of this approach. He recognized the problematic way early empiricists like Locke had accounted for the experience of time. If the concept of change comes originally from experience, then the experience of change can't itself depend on any judgment about what has happened in the past: This would imply an existing grasp of the concepts of time and change.

Russell notes the difference between experiencing change and merely judging that something has changed. We have experiences that seem like direct experiences of motion or other changes. Seeing a clock's second hand move is not the same thing as seeing it occupy, or remembering it occupying, different locations at different times (see figure 2.3). Philosopher Sean Kelly calls this the phenomenon of "pace perceived". The question is, because change is something that happens over time, how can we account for the experience of change at any moment? In defense of an empiricist theory of time-awareness, Russell described the perception of motion or change as the result of our perceiving, at any moment, sense data received over a short, but extended, period of time. His view was that a sense organ, when stimulated, "goes on vibrating, like a piano string, for a while after the stimulation." In the period during which the sensation fades, we literally perceive now what happened a short

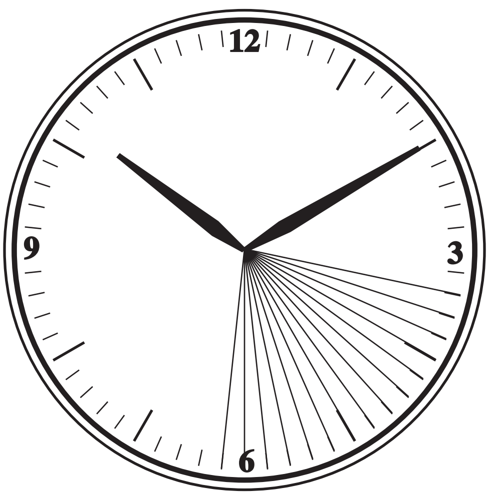

Figure 2.3. Seeing a second hand on a clock occupying several places is not the same as seeing it move.

while ago. It is because of this effect that we see, for example, the movement of a second hand: We can see a second hand moving, he claims, because we literally see it, at one moment, in several places.

Russell's contemporary, H. J. Paton, subsequently pointed out that what Russell describes wouldn't actually amount to the experience of movement or change:

> [I]f in a moment I can sense several different positions of a second hand, then these different positions would be sensed as being all at the same moment. That is to say what I should sense would not be a movement, but a stationary fan covering a certain area, and perhaps getting gradually brighter towards one end. Anything else would surely be a miracle. You can't see a sensum that isn't there. If you see it, it is there at the time you see it.

Paton seems to be making a good point. Simply having some information now that was generated in the past doesn't give you the experience of a sequence of events—unless you are able to make a *judgment* about what you have experienced that involves assigning some of that data to the past. Any such judgment presumes a grasp of the difference between present and past, without helping explain how we come to have such concepts in the first place.

British philosopher Robin Le Poidevin thinks the conjunction of a very recent memory with a present perception "gives rise to an experience of 'pure succession.'" Le Poidevin argues that there is no specific moment when we become conscious of incoming information. Rather, different interpretations of what we perceive, at every moment, battle it out for a very short while—on the order of maybe 80–100 milliseconds—at what we might call a subconscious level, and a 'winning' interpretation eventually emerges. The winning interpretation is influenced by ingrained responses and conditioned

anticipations, plus additional information received later in the interpretive process. In other words, our brains take information accumulated over a short period of time and combine it into what we subsequently experience as a simple and direct consciousness of an event. (As we shall see in the next section, we also know about a variety of 'temporal illusions' indicating that the interpretation of experiences often involves the integration of information received slightly later in the process.)

According to an attractive view called **extensionalism**, there is simply no distinction, on short time scales, between an extended sequence of experiences and an experience *of* sequence. Extensionalism proposes that we perceive succession directly, via acts of awareness that are themselves temporally extended. If so, there is no inference that needs to be drawn from the content of experience to its temporality. Philosopher Christoph Hoerl explains:

> On such a view, experiences of movement or succession are to be analysed in terms of the idea of a distinctive kind of psychological relation of awareness or acquaintance in which the perceiver stands, for a period of time, to events or processes that unfold over that period of time. Thus, on this view, we can conceive of the phenomenal unity between my hearing *do* and my hearing *re* as simply being a matter of them forming successive *parts* of my overall experience of *do* followed by *re*—that is, as two experiences that can *make up* the latter in so far as the tones they are experiences of fall into the scope of one specious present.

Any act of awareness has to itself take some amount of time. As German philosopher Niko Strobach says, "It is just as impossible to see anything at an instant as it is impossible to take a picture by opening the shutter of the lens for zero seconds." However

mathematically or metaphysically correct it might be to insist that any extended magnitude (such as a temporal magnitude) is in principle infinitely divisible, the notion of an infinitesimal present has no experiential relevance. What we get from the extensionalist is the idea of temporally extended acts of awareness, each of which encompasses a temporally extended str*eeeee*tch of perceived events. This conception of experience seemingly would allow for the direct experience of change and succession—that is, without relying solely on inferences about what one *remembers* happening.

This is likely just what the great eighteenth-century Scottish philosopher David Hume had in mind when describing the origin of our idea of time:

> The idea of time is not derived from a particular impression mixed up with others, and plainly distinguishable from them; but arises altogether from the manner, in which impressions appear to the mind, without making one of the number.

In other words, there is no experience of time itself distinct from experienced sequences of events; rather, the idea of time is an abstraction from the direct experience of the "manner of appearance" of perceived sequences of events. Hume continues:

> Five notes played on a flute give us the impression and idea of time; though time be not a sixth impression, which presents itself to the hearing or any other of the senses. Nor is it a sixth impression, which the mind by reflection finds in itself. . . . [The mind] only takes notice of the manner, in which the different sounds make their appearance. [The mind] may afterwards consider [the idea of time] without considering these particular sounds, but may conjoin it with any other objects. . . . Since

> [time] appears not as any primary distinct impression, [it] can plainly be nothing but different ideas, or impressions, or objects disposed in a certain manner, that is, succeeding each other.

Where William James endorsed the notion of an extended present of awareness vis-à-vis the *content* of awareness, the extensionalist's proposal involves applying the idea of an extended present to acts of awareness themselves (see figure 2.4).

If acts of awareness are themselves extended, then a succession of experiential contents can be directly apprehended; thus no need for inference via the application of temporal concepts of obscure origin. According to the extensionalist, sensory perceptions are capable of presenting an inherent dynamism as part of the

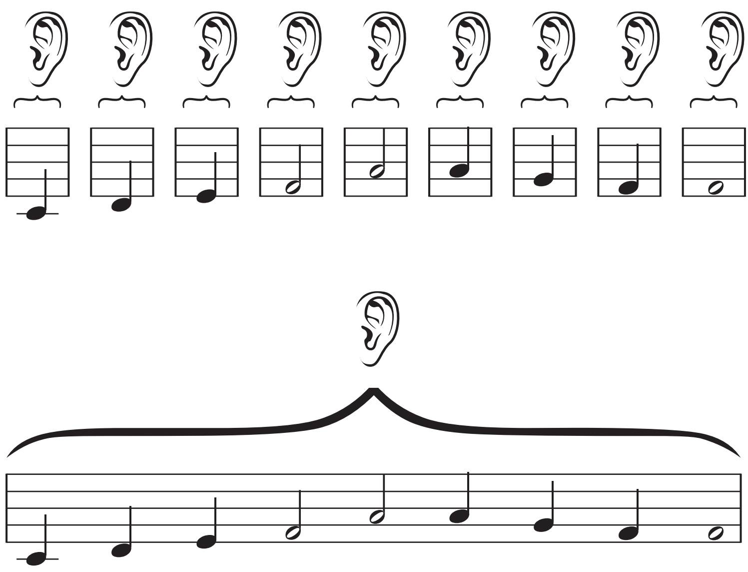

Figure 2.4. A sequence of distinct experiences of individual notes, or a single extended experience of a melody?

fundamental experience itself: The change, say, from *do* to *re* to *mi* is encompassed by a single act of awareness. If ultimately defensible, this idea might validate the empiricist's project of finding the origin of the idea of change in experience. As far as the big picture is concerned, the key point about a theory like extensionalism is that it is, at least, consistent with temporal realism. This proposal would explain the origin of the idea of temporal succession without either begging the question, as in Locke, or adverting to idealism, as in Kant. An account of temporal consciousness consistent with temporal realism would not itself prove that time is real; but if we find this account plausible, it frees us to look into the possibility that there is more to time and change than temporal idealists like Parmenides, Augustine, or Kant would allow.

One standard objection to extensionalism is that it wants us to accept that perceptual contents can be experienced together as part of one experience, and yet not experienced as simultaneous. (Philosopher Barry Dainton calls this the "Extensional Simultaneity Problem".) This does seem like a problem on the face of it. What constitutes an experience? When are we talking about one experience and when are we talking about an awareness that is the result of a series of stitched together component experiences? Without being able to answer this question, it is very hard to decide whether our ideas of time and change are the *result* of experience (as the empiricists claim) or a *precondition* of conscious experience (as Kant claims).

We really have to wait for neuroscience to catch up in order to develop any of these hypotheses to the point where we can really assess a philosophical account like Kantian idealism in light of the evidence. There are multiple neural systems involved in time consciousness: systems for integrating memory into current consciousness, systems for directing attention, systems for regulating

our sleep cycle, systems for integrating information from multiple sensory modalities requiring different processing speeds, and systems for turning inherently discontinuous incoming stimuli into a seamless continuous awareness. There is a lot of work to do in order to understand the very complex involvement of the brain in timing and time perception.

THE CONSTRUCTION OF TEMPORAL EXPERIENCE

As we debate the issue of temporal idealism versus temporal realism, it seems significant that there are several respects in which our experience of the order and duration of events is, demonstrably, a mere construction on the part of our perceptual apparatus. In some contexts, the order of an experienced sequence of events appears to be just a kind of story told by our perceptual processing mechanisms, rather than a straightforward reflection of the order of events. Any temporal realist story we want to supply going forward must take this phenomenon into account.

It's quite common for there to be a difference between what is consciously perceived and the actual timing or order of the raw sensory inputs. In particular, there are many contexts in which one's experience of something that happens *earlier* in time is influenced by something that happens a split second *later*. This is known as **postdiction**. These phenomena reveal a much more complicated story of temporal processing than we might otherwise have suspected. Here are some examples:

- **The Phi Phenomenon**: Two alternately flashing dots near each other can produce the illusion of a single dot moving

back and forth. One seems to see the intermediary movement *before* the second flash, even though before the second flash there is no reason for the illusion of a moving light to occur. Further, when the dots are different colors, the observer can get the impression that the dot changes color in midstream. The illusory midstream color change seems to take place, in each case, before the second flash actually happens. Even before it is consciously perceived to occur, the second flash is somehow influencing how the whole sequence is experienced. (You can easily find animations demonstrating this phenomenon online, such as at https://michaelbach.de/ot/col-colorPhi/.)

- **The Flash-Lag Effect**: An intermittently flashing color filling a moving circle is seen as a mere crescent, while the circle is seen in its entirety. The flash, in other words, seems to lag behind the circle containing it. According to one interpretation, one's perceptual apparatus delays its assessment of the trajectory of unpredictably moving objects; because it is stationary, the flash does not get the same treatment. When the flash occurs, the brain retroactively resets its calculation as to where the circle is (or was?) at the time of the flash. (This is another effect you can find animations for online, such as at https://www.youtube.com/watch?v=K4vyRvMASPU.)
- **The Cutaneous Rabbit**: A subject closes her eyes and is mechanically tapped five times at a point on the wrist, then five times near the elbow, and then five times farther up the arm. (The tapping needs to be regularly timed throughout, so that there is no interruption in the pace of the tapping as it changes location on the arm.) Instead of feeling the taps at those three locations, subjects typically report feeling the fifteen taps more or less equally spaced, running up the whole arm. Of

course, if tapped five times only at the same spot on the wrist, with no further taps anywhere else, the subject reports just the five taps on the wrist. As with the phi phenomenon and the flash-lag effect, later stimuli seem to affect how the earlier stimuli are experienced.

- **Cross-Saccadic Perceptual Continuity**: If you wear a watch with a ticking second hand, you have probably experienced a recurring illusion that your watch has briefly stopped. You look down at it and the second hand seems to have stopped; then, after what seems like just a tiny bit too much time, it starts ticking again. This common phenomenon—sometimes called the stopped-clock illusion—has a *really* interesting explanation. A "saccade" is the term for the flick of one's eyes from one visual target to another. This motion, taking perhaps a tenth of a second or less, is something we do thousands of times a day. Even though our eyes are open during a saccade, we are not aware of the visual information available to us during the movement. If we were aware of this information, it would be very disorienting: The world would seem to shift in place with dizzying speed, over and over again. (Imagine recording a video while jerking the video camera around rapidly. The result would be a confusing mess.) As neuroscientist Kielan Yarrow has explained, what the brain does instead is to effectively extend the perception of the final target of the saccade "backward in time to just before the onset of the saccade". What happens is that the perceived duration of what you are looking at post-saccade gets extended by about the same amount of time it took to move your eyes to it. The intervening information never makes it to consciousness, thus preserving a temporal continuity between pre-saccade and post-saccade perceptual consciousness (see figure 2.5).

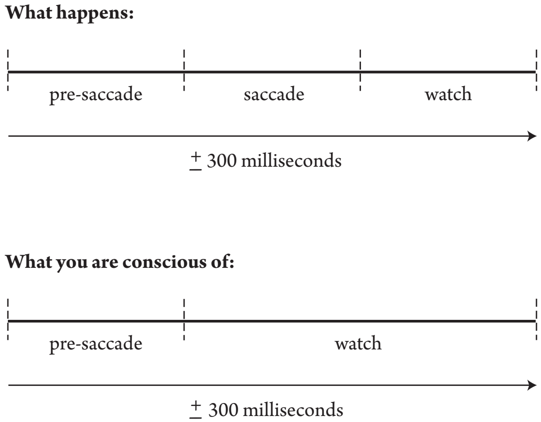

Figure 2.5.

> This erasure is called “saccadic masking”. Usually, we don’t notice this effect. But where there is an external time reference like a ticking second hand, the artificial extension of the second hand’s perceived movement can sometimes make it seem as though the second hand takes more than a second to tick forward; thus the momentary illusion of a stopped watch.

In all these cases, what happens chronologically (slightly) later retroactively affects one’s perception of the whole sequence. Perhaps different interpretive pathways in the brain form multiple, inconsistent interpretations over the course of the stimulus; one of them wins out just because it reflects the sort of interpretation that is simplest or most helpful in most situations. One can speculate on good reasons why temporal processing would have evolved to work this way. Take saccadic masking: Without it, our experience would be full of disorienting and useless visual information. We only notice this striking fact about perception when we experience

the stopped-clock illusion. Our need to coordinate moving and nonmoving visual inputs would explain processing differences revealed by the flash-lag experiment. This also works across different sensory modalities: For example, auditory information is processed faster than visual information to accommodate the fact that sound travels more slowly than light.

On any account, these illusory effects show that time order as we know it in experience does not necessarily correlate with time order in reality—and can even systematically deviate from it. You would generally expect natural selection to favor accurate portrayals of reality, but evidently there are exceptions to this rule. It goes to show how far we must go to fully understand timing and time perception.

What we learn from these phenomena is that, behind the scenes, perceived duration and time order in experience are *constructed*. That our temporal experience is a construction sounds like something an idealist like Kant would like to claim. But it should be stressed that these experiments do not provide any sort of clear support for temporal idealism; indeed, the very nature of these cases involves distinguishing between experienced and objective time, whereas an idealist rejects the notion of objective time altogether. The fact that our temporal experience is to some extent a kind of fabrication of the mind doesn't prove that time order, change, and duration are themselves mind-dependent phenomena. Temporal illusions reveal that particular judgments of order and duration derive from a post hoc process involving different cognitive and neurological modules, only some of which are primarily tasked with accuracy in representation. These experiments create a confusing complication for realist theories of time, but they teach us more about the mind than about time. While they show that our contact with the 'real' time order of events is rather less straightforward than we might have thought, they do not require us to embrace temporal idealism either.

So where does temporal realism stand? We have yet to discuss a modern realist theory about what time *is*, if indeed it is something real. Thus we turn in the next chapter to early modern and twentieth-century physical theories of space, time, and motion.

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Chapter 3

Time and Spacetime

Thanks to its being championed by the Roman Catholic Church, Aristotelian physics persisted through the European Middle Ages as pretty much the unchallenged approach to understanding nature. This situation began to change in the sixteenth and seventeenth centuries with the arrival of the Scientific Revolution, the rebirth of experimental and mathematical science in Europe after religious authorities had quashed or redirected the open pursuit of knowledge for over a thousand years. Many important scholars and scientists were associated with this movement—for example, Galileo Galilei, Francis Bacon, Émilie du Châtelet, Christiaan Huygens, and Robert Boyle—but the work of Isaac Newton had the greatest impact. Although other scientists had disproved certain elements of Aristotelian or Roman Catholic dogma (most famously, the geocentric model of the universe), Newton produced a comprehensive system of physical laws that superseded what had been the received view since ancient times. This system persisted until the twentieth century, when revisions to Newtonianism took our understanding of time to a whole new level.

A Brief History of the Philosophy of Time. Second Edition. Adrian Bardon, Oxford University Press.
 DOI: 10.1093/oso/

REPLACING ARISTOTLE

Newton's most synoptic achievement was his execution of the idea (earlier conceived by Galileo) that there could be mathematically describable laws of motion. These laws would be quantifiable, invariable, and universal, and would involve just mechanical and gravitational interaction. This was a huge break from traditional Aristotelian physics, which explained phenomena primarily by reference to intrinsic properties of things, rather than by mechanical interactions and forces acting according to uniform and universal rules. As we shall see, Newton's views on the nature of time are intimately bound up with this project.

In his *Philosophiae Naturalis Principia Mathematica,*[1] commonly known as the *Principia,* Newton identified a connection between the possibility of these universal laws of dynamics and the very real existence of time and space as entities in their own right. Most important, he was convinced that, to have the status of universality, his rules would have to pertain to what he called "absolute" and "true" motion rather than mere "relative" motion. The concept of **relative motion** is easy to understand. A sailor walking forward on a ship at one foot per second is moving one foot per second relative to the ship; if the ship is moving forward at ten feet per second relative to the ocean, then the sailor is moving eleven feet per second relative to the ocean. Relative motion is motion merely with regard to some other body, or with regard to a 'place' defined by some other body or bodies (such as a ship's quarterdeck, or the corner of Fifth Avenue and Main Street). Being in motion relative to some other thing doesn't necessarily mean you are truly in motion: For

1. *Mathematical Principles of Natural Philosophy*.

example, someone sitting still while being passed by a train is in motion relative to the train.

In Newton's system, relative motion stands in contrast to **absolute motion**. He describes the scientific measurement of absolute motion in terms of the only values by which such motion could be measured: **absolute space** and **absolute time**. Absolute motion is motion through absolute space, with the rate of motion given in terms of absolute time. (He introduces these concepts immediately before the statement of his three famous laws of motion, familiar to anyone who took high school physics.) "Relative space" refers to the space taken up by a body at any point, or to a place defined in relation to the position of other bodies; relative motion is motion relative to some place or other body. Absolute motion of a body, by contrast, is motion with respect to absolute, "immovable space". Absolute space is the (presumed) underlying three-dimensional field in which all bodies have some absolute position, independently of anything else. "Relative time", which Newton also calls "apparent" or "common" time, refers to the measurement of durations or processes by reference to some other motion, such as the movement of a clock's minute hand. This he distinguishes from absolute time, which "of itself, and from its own nature, flows equably without relation to anything external." As Louise Heath notes in *The Concept of Time*, the Italian cosmologist Giordano Bruno had claimed that "no absolutely regular motion can be discovered" and thus "we can have no absolute measure of time". Newton rejected this claim. Absolute time, he argued, is needed in sciences like astronomy as a corrective to "common time". For example, the length of a solar day varies slightly and so cannot be used for mathematically precise astronomical formulas or predictions.

What does it mean to be a Newtonian realist about space and time? Newton could have been more clear on this question. He did

not think space and time were material substances, like rocks or trees. Rather, he thought of them as sui generis entities—entities of a kind all their own. They essentially function, for him, as universal containers for, respectively, bodies and events. As such, they are not themselves bodies or events; nor are they constituted by bodies or events—but they are nevertheless real and a precondition for the possibility of what they contain. For Newton, even if there were no objects in the universe, there would still be something there: Space would be there. If there were no events in the universe, something would still be happening: Time would be happening.

This means that, although events in time are dependent for their possibility on the existence of time, time itself with its inexorable "flow" does not depend on events. According to Newton, time would still pass in a universe devoid of any motion or other change. The very notion of absolute time is a repudiation of an Aristotelian understanding of time: On the Aristotelian understanding, because time is just the measure of change, the notion of time passing without change is incoherent. This is, therefore, a fundamental departure from Aristotle's temporal relationism.

Newtonian realism might be the formal view of time that most closely follows a colloquial understanding of time. It is typical for human beings that we think of time as a kind of inexorable flow that sort of carries events (or us) along. This is reflected in innumerable idioms like "the passage of time", "as time goes by", "a race against time", "Time waits for no one", "Time flies", or "Time heals all wounds". Similarly, we tend to think of both ourselves and the events we experience as somehow contained in a dynamic temporal dimension; thus we say that some event happens "in time", "over time", or "at a time".

For Newton himself, the rejection of the Aristotelian approach has mainly to do with the usefulness of time as a metric in

describing motion and the forces involved in motion. His reason for embracing the concepts of absolute space, time, and motion was that he thought that universal laws of motion were describable only in such terms. Laws of motion referencing mere relative motions could not apply universally, because relative motion is determined by the contingent motions of other bodies. The explanation of *changes* in motion (i.e., acceleration) by reference to forces is the heart of Newton's system. This, in turn, requires absolute motion, because relative motion doesn't require a force being applied to any particular body. Thus an underlying, immovable, real space must be postulated in order to distinguish real motion through space from mere relative motion. Further, because any motion, such as the rotation of the earth, can be irregular, the time used to describe universal laws of motion cannot depend on the motion of any object. Hence the need, if Newton's whole project is even to be possible, to presuppose a process—the regular passage of absolute time—independent of the motion of any object.

On Aristotle's relationist view, time is a mere abstract measure of change. Newton's theory, by contrast, treats time as a real thing unto itself. With this theory, Newton has fundamentally broken with any perspective holding time to be dependent on change; change is now best described as something that happens *in* time, even as time itself flows along. Newton treats time like a *thing*—not, indeed, a material substance like a tree, a cow, or a body of liquid, but still something that has noun status. His understanding of time is therefore radically different from either a relationist or idealist conception: This is the first serious example of a formal temporal realism.

So far, we have only described the concept of absolute time as a presupposition underlying (in Newton's mind, at least) the possibility of universal laws of dynamics. What reasoning or evidence

did he present in support of the claim that absolute and true time really exists?

His key line of reasoning was that there must be absolute time if there is evidence for the existence of absolute motion. As an illustration, he noted the action of water in a rotating bucket: The surface of quickly rotating water in a container becomes concave as it pushes out toward the sides of the container. Newton pointed out that the spinning water will demonstrate this concavity when it is spinning just as fast as the bucket itself (see figure 3.1). The main point here is that the water's concavity can't be explained by reference to the relative motion of the water versus the motion of the bucket. He also cites the outward force you seem to feel while swinging a weight on a cord in a circle around you, aka "centrifugal effort". Where is that

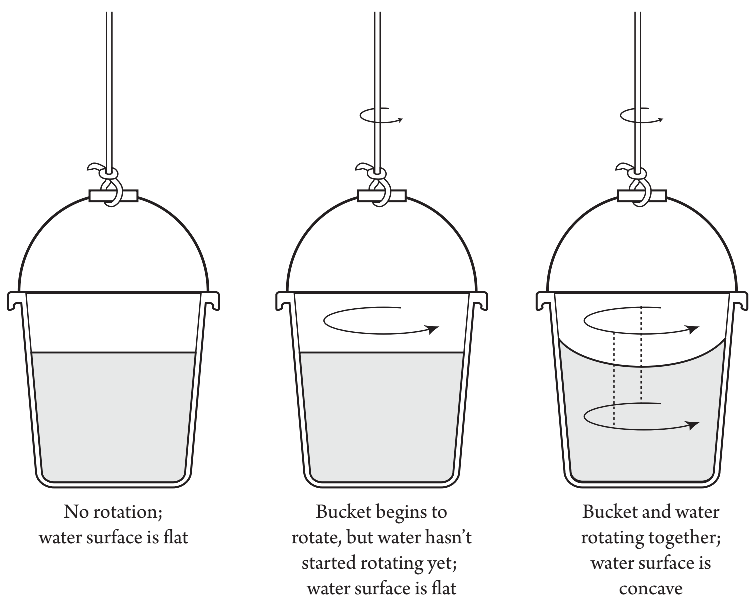

Figure 3.1.

force coming from if the weight is not really moving (i.e., in absolute terms)?

All Newton could directly conclude from phenomena like these was that rotational motion cannot be explained just by reference to the rotating object's motion relative to its immediate material surroundings. His interpretation of rotational effects like the centrifugal effort of the water in the spinning bucket is that the water is experiencing true, absolute motion—defined as motion relative to absolute, immovable space itself. If there really is absolute motion in Newton's sense, then every such motion must take some fixed amount of time. Further, this time measure—because it correlates with absolute motion and describes all true motion—must be distinguished from any time measure derived from any particular regular(-ish) motion we observe, such as the orbit of the moon or the movement of the hands of a clock.

Newton thought he saw concrete evidence of an absolute, underlying regularity of the passage of time in the synchrony of certain kinds of motions. We have said that the solar day is slightly irregular—but irregular compared to what? It is irregular compared to various astronomical motions, such as the orbits of the moons of Jupiter, or to a pendulum clock. But why not suppose that the solar day is regular and these other processes are the irregular ones? Simply because these other processes agree so nicely with each other. Newton thought that the best explanation for the agreement between certain kinds of otherwise-unrelated motions was that they were somehow tracking the absolute, regular flow of universal time. Many later scholars, such as nineteenth-century American philosopher Charles Pierce, adopted Newton's realist view as common knowledge; Pierce described the existence of a flow of time, and the difference between the actual past and merely potential future, as "too obvious for argumentation".

Absolute space and time allow real (i.e., non-relative) motion to be explained by quantifiable and consistent rules. True, absolute space and time permit a physical theory that (allegedly) directly and literally describes nature itself with or without us; in contrast, Aristotle's time is a mere abstraction by which we understand or measure natural phenomena. Thanks in large part to Newton's work, Aristotelian physical science, which had dominated Western science for nearly two thousand years, was supplanted by a system of rules of nature that were explanatory, quantitative, and yielded testable predictions; this is why Newton is the most important figure in the history of modern science—and we now understand that his entire project stands or falls with his conception of time.

NEWTON AND LEIBNIZ

One of Newton's contemporaries was the German logician, theologian, and all-around polymath Gottfried Wilhelm Leibniz, who had very different ideas about physics and criticized Newton's conclusions from afar. By 1715, these two renowned thinkers had been part of a nasty, public conflict over who should have credit for the development of calculus (Leibniz had published his version first, but Newton had independently developed a slightly different method for solving the same kinds of problem years before). Newton and his intermediaries had flatly accused Leibniz of plagiarism; further, Leibniz was a vocal critic of Newton's physical theories, and for this as well he was attacked by Newton's many supporters.

Fortunately, Caroline of Ansbach—the Princess of Wales at the time and a student of philosophy herself—was a close friend of Leibniz. She was able to arrange a public correspondence between Leibniz and Samuel Clarke, an ally of Newton who was understood

to be speaking for him in the correspondence. The subject of the letters, published in 1717, was Clarke's defense of Newton's doctrines of time and space against Leibniz's theological and philosophical criticisms. In his contributions, Leibniz defends an Aristotelian conception of time (though, unlike Aristotle, his motivation for rejecting realism about time was primarily theological in nature). Leibniz's main objections to Newton's temporal realism can be concisely summarized as follows:

- Time cannot exist in itself because, were time real, it would still only exist at any moment in the form of an instant; and nothing can be composed of instants. If time can't be composed of instants, then what is it made of? Not matter or energy, or "immaterial spirits" (as Clarke proposes at one point); but what else is there?
- Leibniz argues that, if time were a thing in itself, and God is 'in' time, then God would be dependent for His existence on the existence of time. And God, being perfect, must be fully self-sufficient.
- If time were an independent existent, then there would be a question as to why God created the universe at one time rather than another. God being perfect, He could never act whimsically—that is, without good reason. But (as Augustine had also noted) if time exists for God, then there could be no reason why He would choose one moment of empty time to get things started, rather than another. So this conception of time must be wrong.

Leibniz adds some parallel points about the idea of absolute space. Absolute space would have to be actually composed of infinitesimal points (which doesn't make sense). Further, if everything is in

space then God would have to be in space and thus dependent on it. Finally, absolute space means God would have needed to make an arbitrary choice as to the orientation and location of the universe as a whole. (Place everything where it is now, or three feet over to the right? Facing this way or that way?) These cosmic decisions as to the placement of all reality vis-à-vis invisible space would be both inevitable and arbitrary. Eighteenth-century French scientist and philosopher Émilie du Châtelet (herself an idealist about space and time) agreed with Leibniz on this point: She argues that Newton's space and time are useful intellectual tools but could have no real existence independent of objects and events.

Leibniz's alternative is a conception of time as an abstract set of relations holding between events, and space as an abstract set of relations holding between objects. In denying that time exists in itself, Leibniz denies temporal realism. Neither is he a temporal idealist, in that, like Aristotle, he thinks that the time relation plays a legitimate role in scientific accounts of the universe. Thus we classify him as a relationist, just like Aristotle (and like another probable influence, eleventh-century Persian-Arabic philosopher al-Ghazali); the major difference between Leibniz and Aristotle is that Leibniz's relationism derives primarily from a perceived conflict between temporal realism and his own theological doctrines.

In response to Leibniz's objections in the *Correspondence,* Clarke points out that time is treated as a "quantity" (i.e., something that can be measured and that there might be more or less of) in both everyday and scientific parlance. Leibniz, he claims, also ignores the empirical evidence for absolute motion (i.e., the effects of acceleration), which presupposes absolute time.

Leibniz hated the idea of absolute motion. Imagine a universe of bodies all in (absolute) motion in the same direction and at the same rate—imagine, say, that everything in the universe is drifting

to the left at five meters per hour. There would be no effective difference, Leibniz insists, between this scenario and one in which everything is at absolute rest. The fact that the concept of absolute motion appears to make the contrast between these scenarios meaningful shows it to be incoherent, he claims, for two reasons: First, the difference between the two situations has no observable consequences; second, God would have no reason to prefer one over the other and so would necessarily act without reason if forced to pick one over the other.

However, as Clarke repeatedly points out, Leibniz has no convincing explanation for the water's centrifugal effort in Newton's spinning bucket. All Leibniz can say is that, well, such is the nature of rotational motion: It exhibits an intrinsic force that other sorts of motions do not. Newton's laws, in conjunction with his postulation of a universal gravitational force, do a very good job of explaining and predicting observable phenomena. Leibniz had his own theories of motion; we won't go into them here, but suffice it to say that they had much less explanatory and predictive power.

Newton believes in time because of its usefulness in his physics. But what does he think it actually is? Even in his absolutist language, time is defined more in terms of what it *does* (i.e., flow, or pass, or lapse) than in terms of what it *is*. This is pretty typical when it comes to discussions of the nature of time. Partly for this reason, the ontological question about space tends to be "Is space real?"; whereas the ontological question about time, instead of "Is time real?", is more often stated as "Does time really pass?" But this question about the passage of time presupposes the main question. If we want to make any sense of time as a thing that passes, we need to think of it as a real, independent process of some sort. As difficult as it is to wrap your mind around the question "Is space real?", it is even harder with time. If you don't think about it too closely, you can sort

of vaguely imagine space as a medium—as a kind of invisible soup in which we float around like croutons. What is the analogous image for time that allows us to represent it, imaginatively, as a real, independent process in the world? Something being "in" space sounds like it makes sense—being "in" something else is literally a spatial relation, after all. Something being "in" time is more like a metaphor. A metaphor for what? Lacking any way to get a grip on the idea of time as a real existent, how do we reconcile Newton's success at a comprehensive theory of motion and gravity with his failure to offer a theory of the nature of time, when his physics (as he saw it) is so intimately bound up with the existence of absolute time?

Post-Newtonian physics may help with the problem by replacing Newton's absolute space and time with the concept of relativistic **spacetime**. To understand the modern concept of spacetime, and how it might help us decide if there really is such a thing as time, we need to look at how Newtonian physics was superseded by Einstein's theory of relativity.

RELATIVITY

Newton's theory remained the almost universally accepted account of motion and gravity until the late nineteenth century, when it came under serious examination by experimental physicists. The key discovery that led to Albert Einstein's revolutionary theory had to do with light. Einstein's breakthrough (building on a lot of work by others) had to do with the combination of a couple of facts about light, plus one extraordinary experimental finding about its behavior. First, as Newton was also aware, the speed of light is finite; the Danish astronomer Ole Christensen Roemer had identified and reported this fact in 1676. Second, by the late nineteenth century

it had become widely accepted that light was a variety of electromagnetic radiation that propagated itself in a wavelike manner. The shocking experimental finding that opened the door to Einstein's theory was that the speed of light is a constant regardless of the velocity of the source.

Some reasoned that, if light moves in a wavelike manner at a finite speed, there must be some medium through which it travels; if ocean waves, for example, are disturbances of water, and light is like a wave, then light must be a disturbance of something. The proposal considered by American physicists Albert Michelson and Edward Morley in 1887 was that light (or any electromagnetic radiation) propagates itself through an underlying, invisible, and fixed medium called the **aether**. (Some proposed that the aether was simply Newton's absolute space.) If so, one would expect that light measured in the direction of its motion should appear to travel more slowly, and light coming from a source toward which we are moving should appear to be going by faster—much as ripples in a pond will appear to move more slowly if we are moving along with them, and will appear to go by more quickly (in the opposite direction) if we are moving toward their source. Michelson and Morley were amazed to discover that the speed of light is constant: In a vacuum, light travels at the same speed regardless of the velocity of the source of the light or one's velocity relative to the source of the light. If, say, you throw a ball forward at ten miles per hour while running in the same direction at ten miles per hour, the ball will be traveling at twenty miles per hour. But light travels away from its source at a constant speed regardless of what the source is doing. Unlike an object launched from a rapidly moving vehicle in the direction of travel, a beam of light projected from that vehicle will travel at the same speed as if it had been projected from a resting source.

This result tends to undermine the notion that the propagation of light has anything to do with an aether. You can't overstate the importance of this discovery, which physicists initially resisted. Newton had accepted that, from any observer's viewpoint, *mechanical* laws of nature will always operate the same way, so there is no method involving the behavior of objects that can reveal absolute (vs. merely relative) constant velocity. The Michelson-Morley result showed that differences in the speed of light can't be used to establish absolute velocity either; thus the notion of an underlying, fixed aether (or a Newtonian absolute space) is inoperable in describing motion.

This is where the theory of relativity comes in. While Albert Einstein was still working as a patent clerk in Switzerland, he worked out the basics of a new theory about the nature of space and time. It starts with a theory about motion. Where others tried to find some loophole, Einstein took seriously what the Michelson-Morley experiment had suggested: that the speed of light in a vacuum is a constant. He proposed that the notion of absolute velocity, being irrelevant, should be dispensed with altogether.[2] Without an aether, or some other stand-in for absolute space, absolute motion is not only undetectable but also meaningless. Einstein proposed that all laws of nature (meaning all mechanical laws, plus the newly discovered rules governing electromagnetic phenomena like light, plus anything else besides) are the same for any observer regardless of his/her constant velocity relative to anything else. This

2. This refers to constant velocity, not acceleration. Thus it does not directly apply to rotational motion (which is accelerated motion), as in Newton's bucket. Newton failed to note that the water in the bucket is rotating relative to the rest of the universe; some have argued that this relative motion could explain centrifugal effort in such cases. If so, then the effects of rotational motion don't prove absolute motion the way Newton thought they did.

simple idea—since confirmed many times over—has profound consequences for our understanding of time and reality.

Once you examine the consequences, it becomes clear that the extraordinary fact that the speed of light in a vacuum is a constant, when added to the elimination of the idea of absolute motion, renders superfluous any proposal about a Newtonian absolute time. This conclusion is already evident in Einstein's limited **special theory of relativity** [STR], which amounts to a simplified account of time and space that doesn't concern itself with mass and gravity (as the later **general theory of relativity** does).[3] To use a familiar illustration, imagine two observers moving relative to each other: One (Albert) is on a train traveling west to east, and the other (Isaac) sits on the train platform. Just as the train passes, two bolts of lightning strike: one a mile to the west and one a mile to the east. A very short time later, Isaac sees both flashes simultaneously. Knowing the distance to each strike, he concludes, reasonably enough, that the two strikes occurred simultaneously (see figure 3.2).

But is he right? Albert disagrees with Isaac; for Albert, the flashes do not arrive simultaneously. Isaac thinks he has a simple explanation for Albert's confusion: The light coming from the west had to catch up with Albert, and Albert is approaching the light coming from the east (see figure 3.3).

This answer would work just fine, *if* you could say that Isaac is really at rest and Albert is really in motion. But we cannot. Remember that there is no way to determine absolute velocity; Einstein's diagnosis is that this is because *there is no such thing*. In the illustration above, Isaac is misguided in his assessment as to what is going on.

3. During the time of the development of the special and general theories of relativity, Albert Einstein was married to Serbian physicist and mathematician Mileva Marić. Though the extent of her contributions cannot be verified, she likely was a significant partner in the development of these ideas.

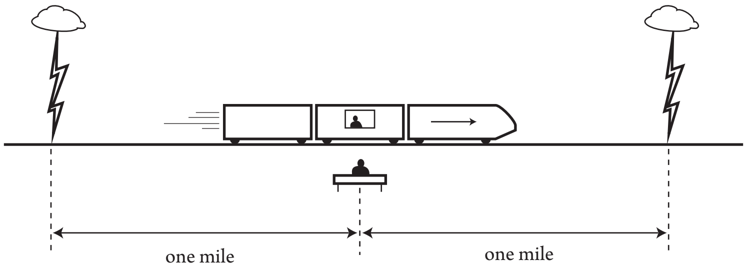

Figure 3.2. This diagram illustrates Isaac's experience only, with the times and distances only as he measures them.

Albert can equally well say that he is at rest and Isaac is in motion as the earth flies by beneath the train. Because the equidistant lightning strikes arrived at Albert's location at different times, Albert is as justified in saying they were *not* simultaneous as Isaac is in saying that they *were* simultaneous. Without absolute motion, neither is right and neither is wrong. They just each have a different inertial **frame of reference**; each describes the situation from the standpoint of his frame of reference, and there is no authoritative, independent standpoint that would decide the matter. This means that there is no absolute, objective fact of the matter as to whether the flashes are simultaneous: Simultaneity is relative. If simultaneity is relative, then absolute time has no role to play. No one can say when a given event occurs, or what time it is now, with an authority that transcends one's particular perspective on things. *What time it is 'now' depends on one's choice of reference frame.*

Another well-known thought experiment further illustrates this fact. Imagine a simple clock that measures time with a light pulse reflected back and forth inside a vertical tube (figures 3.4–3.6). Isaac and Albert each have their own clock. From Isaac's perspective, the light pulse in Albert's clock has farther to travel for each round trip

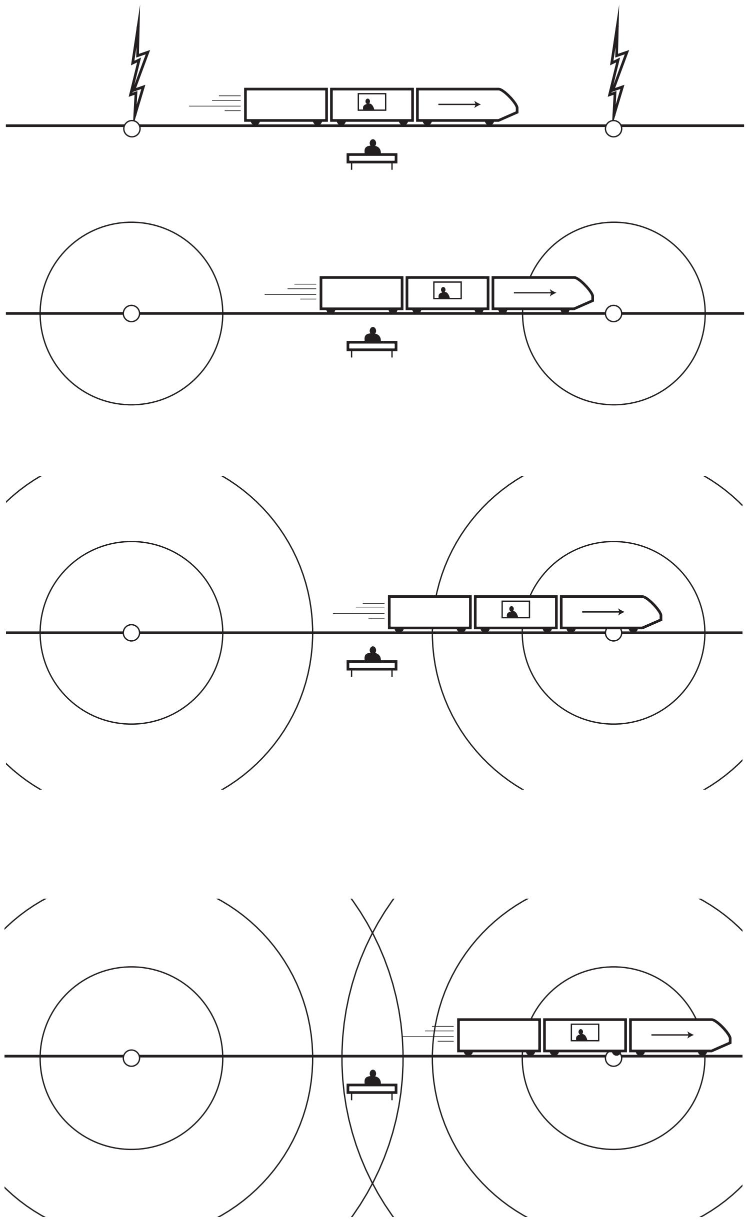

Figure 3.3. Isaac's diagnosis of Albert's 'mistake'.

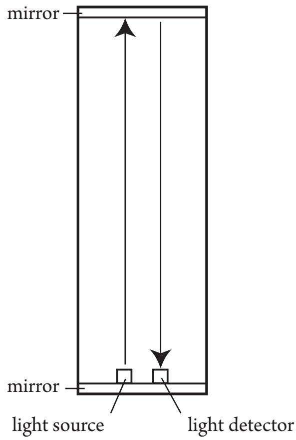

Figure 3.4. Now, put a clock like this on the train with Albert, and compare Albert's experience of the clock with Isaac's as the train passes by (figure 3.5).

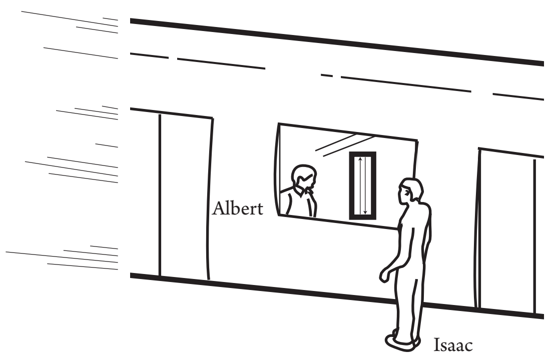

Figure 3.5. Note the path of the light pulse from Albert's perspective versus its path from Isaac's perspective (figure 3.6).

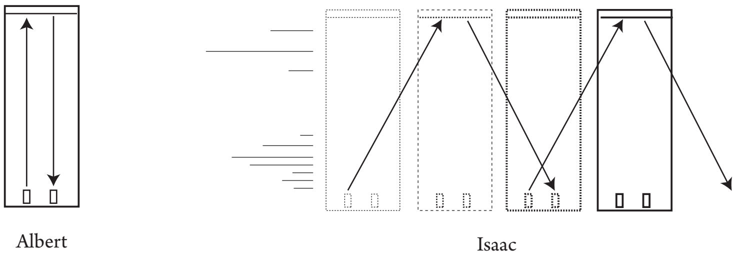

Figure 3.6.

than the one in his clock. Consequently, Isaac sees Albert's clock as ticking more slowly than his own; according to Isaac, Albert's clock is slow. But suppose Isaac has a light clock just like Albert's. From Albert's perspective, the path of the light pulse in Isaac's clock looks just like the path of the light in Albert's clock as seen by Isaac. For Albert, Isaac's light clock is the slow one. In fact, they would each be wrong in finding the other's clock to be slow, because in either case their finding about the other person's clock time presumes absolute motion and absolute time. Neither Albert nor Isaac can be said to be in a state of either absolute motion or rest; they simply have different frames of reference, and thus different **coordinate systems** (i.e., different ways of mapping events in space and time). This means that the rate of time's supposed passage is relative to one's frame of reference. You can't use your clock, in your frame of reference, to describe what is happening in another frame. There is no single, objective time applicable to all.[4] There is no definitive 'God's

4. This conclusion seems so awfully counterintuitive. But there's an easy answer as to why it might feel that way. Relativistic effects like the ones we are discussing here would only be observable given extremely high relative velocities and/or extremely sensitive instruments. We didn't evolve under conditions where these effects were either noticeable or relevant, so we wouldn't expect our perceptual or cognitive faculties to be adapted to a world in which these effects matter. As a result, it feels distinctly unnatural when we try to tackle relativity either

eye' view that would, even in principle, tell you who is right and who is wrong. *The universe has no opinion as to what time it is.*

It is important to be clear on what is happening here. Going fast doesn't make time slow down. This would be mistaken in two respects. First of all, there is no such thing as going fast in absolute terms: Going fast versus being at rest are relative. Second, there is no absolute time to be sped up or slowed down; there is only my measurement and your measurement, which simply will not agree if we have different relative velocities. This is not the same as saying that the truth of things under STR is merely *subjective*. The different spatial and temporal coordinates observers may assign to events, using their own clock, is a matter of having a different *perspective* on a single, agreed-upon objective reality of events. It's just that this objective reality does not include absolute time, space, or motion.

The theory of relativity makes a lot of very specific predictions on the basis of its supposition about the relativity of motion; observations on the level of large-scale events have confirmed this theory again and again. Relativity dispenses with any need for an objective background flow of time and provides no basis for any claim about what time it is independent of one's own frame of reference. In modern, relativistic physics, space and time are replaced by **spacetime**. The main reason for this is that spatial and temporal quantities individually vary according to one's frame of reference; there will, however, be an invariant quantity (known as a **spacetime interval**) that can be decomposed into separate spatial and temporal quantities in innumerable ways according, again, to the observer's frame of reference. The concept of spacetime is useful for this reason: Although different observers will assign different

imaginatively or intellectually. Yet the theory of relativity has been experimentally confirmed in many different ways.

spatial and temporal coordinates to events, all can agree on a single, objective reality described mathematically in terms of four-dimensional spacetime. Furthermore, although velocity in space is relative, velocity in spacetime is not. In a somewhat loose manner of speaking, whereas nothing can go faster through space than light, everyone and everything is 'moving' at the speed of light through spacetime. How much of one's constant velocity is measured as velocity through time versus velocity through space depends on one's frame of reference, but the combination of one's motion through space plus one's motion through time always adds up to the speed of light.

Relativity thus seems to tell us we must think in terms of a real quantity—spacetime—in order to address the ancient question of the reality and nature of time. Or, to put it a little more modestly, the postulation that there is such a thing as spacetime works in creating an effective mathematical model of what is going on. Now we need to understand spacetime a little better, because we need to get into position to ask the question: Is spacetime real?

WHAT IS SPACETIME?

In support of Einstein's theory, around 1908 Polish mathematician Hermann Minkowski worked out the mathematics of spacetime. In a lecture he said the following:

> The views of space and time that I wish to lay before you have sprung from the soil of experimental physics, and therein lies their strength. They are radical. Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and

> only a kind of union of the two will preserve an independent reality.

We have seen that observers in different inertial frames, like Isaac and Albert, will disagree on the temporal intervals between events. They will also disagree about spatial intervals. Because the speed of light is constant for any inertial frame, spatial distance can be measured by the amount of time it takes light to travel from one point to another; thus the concept of a "light-year" (i.e., the distance traveled by a beam of light, in a vacuum, in one year). This means that there is a deep connection between the measurement of temporal intervals and the measurement of spatial intervals. If Isaac and Albert can't agree on what time it is, then they will also have different readings on spatial distance: They will not agree on the elapsing of one year, so what Isaac measures as a light-year of spatial distance will not be the same as what Albert measures as one.

All is not chaos in determining spatial or temporal intervals, however. *Spatiotemporal* intervals are constant for all observers. An observer in one inertial reference frame might measure a smaller spatial interval, but a larger temporal interval between two events; and vice versa for a different observer. But spatial and temporal intervals vary in an orderly way such as to allow for an identifiable spacetime interval between all events—one that all observers can agree on. This is what Minkowski meant when he said that only a union of space and time "will preserve an independent reality".

At this point, it would be nice to be able to draw a diagram showing how objects and events are arrayed in spacetime. While spacetime can be represented mathematically, it is not possible to produce a single pictorial representation. Each observer experiences it differently with equal authority. One could try picturing a block of events carved at different angles for each observer, but that would

really only depict a Newtonian three-dimensional space, not a relativistic four-dimensional spacetime. Minkowski came up with a clever way of visually representing spacetime, though only from the perspective of a particular observer: the **light cone**. From a given observer's perspective at a given time, all of reality can be divided into three components: one's past light cone, one's future light cone, and one's **absolute elsewhere**. Let's take Isaac again. What falls into Isaac's past (i.e., anything within his past light cone at a given moment) is limited by the speed of light, which relativity assumes cannot be exceeded. The past light cone indicates the spatial distance of those events that could have causally affected Isaac by now, or of which he could be aware. Imagine beams of light arriving at Isaac's location from all directions; the surface of the past light cone represents the path of those beams, while the inside of the past light cone represents all slower-than-light events capable of affecting him. Conversely for his future light cone: The surface represents the spatial distance of future events that he could causally influence by sending out a signal at the speed of light. (See figure 3.7) As it is sometimes said, the speed of light—which is the upper limit on the speed of anything—is also the upper limit on the speed of *causality*.

The light cone represents spacetime from the perspective of some generic observer, such as Isaac and/or anyone else at his location and in his inertial frame.[5] (Note that the past and future light cones should be understood three-dimensionally: Isaac's future light cone, for example, really represents an expanding sphere of possible influence.) We say that the events within Isaac's past and

5. "Proper time" in the diagram refers to time as measured by a clock following a specific spacetime path. Each observer will have his or her own proper time. Proper time is a matter of *perspective*, but this does not make proper time *subjective*. While there are different ways to describe the spatial or temporal location of an event, facts about spacetime intervals between events are objective.

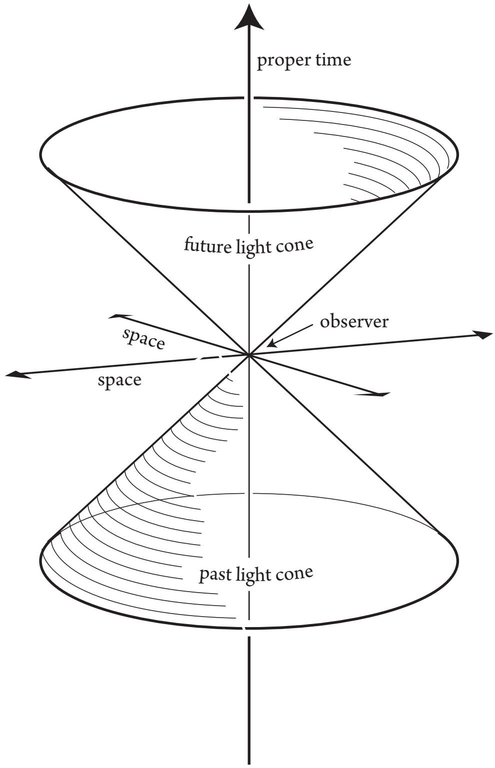

Figure 3.7.

future light cones are **time-like separated** from Isaac. Events that are time-like separated are such that a causal relationship could exist between them. Isaac's absolute elsewhere—the area that falls outside Isaac's light cone—represents the set of events such that people at his spatial location, but moving at different speeds, will disagree on which event in that area is simultaneous with a given event occurring at his location; we say that events falling outside of his light cone are **space-like separated** from him. (The lightning strikes in the earlier illustration were space-like separated from both

Albert and Isaac at the moment they were passing each other—but time-like separated from each at a later moment for each.) In this way, we can place everything into one spacetime and explain why different perspectives on things like velocity and spacetime coordinates differ by reference to how an observer's coordinate system, at a given moment of observation, breaks down events into some that are time-like and some space-like separated from the observer.

Thinking of spacetime as a real, substantive venue for events becomes even more important in the context of Einstein's expanded general theory of relativity [GTR], which offers a new theory of gravity and, in so doing, accounts for the perspectival effects of mass, gravity, and acceleration. Unlike constant velocity, acceleration is not a merely frame-dependent issue, so its objective characteristics need to be differentiated from velocity. The way GTR does this is in terms of trajectories though spacetime: Unlike constant velocity, acceleration is expressed in terms of a nonlinear trajectory though spacetime. Further, GTR explains gravitation in terms of distortions in spacetime related to the presence of mass. Unlike in Newtonian mechanics, relativity does not treat gravity as a *force*. Just think: If you jump off a bridge or high diving board, do you feel a force pulling you toward the water? No. You feel nothing outside of some air resistance. Gravitational attraction toward, say, a planet is explained simply in terms of the object moving freely on a straight line (or "geodesic") in *curved spacetime*. Gravity is just a function of local spacetime geometry. If so, then it's the local properties of (real) spacetime itself that could be said to explain gravity.[6] Further, physicists have recently confirmed one of Einstein's key predictions:

6. Einstein himself sometimes described it the other way around, wherein spacetime is an abstraction that is mapped onto a more fundamental gravitational field; in other words, he sometimes described spacetime in what sounds like relationist terms. Relationism about spacetime continues to play a role in recent and contemporary physics. But others working

that gravitational events create distortions in spacetime (called "gravitational waves"). Put all this together and it sounds like spacetime is a real medium with properties of its own.

The concept of spacetime functions as an extremely accurate and useful tool, mathematically speaking, to explain both the relativity of velocity and the non-relative forces of acceleration and gravity. In contemporary physics, it is not uncommon to talk in terms of a real spacetime that contains, or constitutes, the universe of objects and events as we know it.

SPACETIME REALISM

We will come back to the theory of relativity in the next chapter when we talk about the reality of the passage of time; the implications of the relativity of simultaneity will come into play once again there. In the meantime, let us focus on the idea of spacetime itself. Now that we have dispensed with Newton's absolute space and time, what about Minkowski spacetime? Is it a real thing? Physicists do not necessarily spend much energy on this question, because the success of physical models at explaining and predicting phenomena doesn't require an answer to it. Yet some physicists, and many philosophers, have tried to tackle this issue as best they can. We have seen that relativity treats spacetime as a sort of four-dimensional block with properties of its own, such as curvature and its status as a medium for the transmission of gravitational waves. But if it is a block, what is the block made of? Answers to this question tend to get rather abstruse. One classical realist proposal is that spacetime is constituted

on relativity have taken to a realist understanding of relativistic spacetime. Einstein certainly thought his theory was incompatible with Kant's idealism about space and time.

by momentary spacetime points (perhaps defined by coincidences in the worldlines of elementary particles); a variation on this proposal is that spacetime is made up of spacetime points but also involves the metrical relationship between those points as part of its identity. (The latter version is intended to solve a major problem with the simpler version, in that the simpler version appears to leave the actual distribution of points in spacetime inert for explanatory or predictive purposes.)

The replacement of Newton's absolute space and time with Minkowski spacetime would not satisfy Leibniz: He would want to ask whether it would be possible for the entire universe of material bodies to be oriented differently with regard to this real spacetime. The question of whether we inhabit this universe or its mirror image has no practical or observable consequences. Yet anyone who is a realist about spacetime must take this sort of possibility seriously. Leibniz would complain about such a possibility on theological grounds (pertaining to God not having any reason to choose one distribution over another); but one could also complain, from a purely scientific standpoint, about being told there were two different physical possibilities (i.e., that we live in this universe or its mirror image) with no possible observational difference. Philosophers of science sometimes express doubt that any purported scientific theory that allows such alternate, indistinguishable possibilities can be considered a satisfactory physical theory.

Further, recall that Aristotle had pointed out the impossibility of anything being composed—literally constructed out of—infinitesimal points. A Euclidean point has zero length, and no number of items of zero length add up to something of non-zero length. We need to avoid the idea of an infinite number of definable, finite spatial segments between any two points; this is how we get Zeno's paradoxes of motion. This would seem to rule out any view

of spacetime as composed of points. How can spacetime be composed of points if a collection of points cannot add up to anything? If the bits making up spacetime are not mere mathematical fictions (like Euclidean points), then what are they?

In light of these concerns, it is problematic to think of spacetime as composed of units the way a brick wall is composed of bricks. Barry Dainton muses that "it may be that not all real substances can be broken into parts in the way of macroscopic material things." In other words, if one wanted to think of spacetime as a real thing, one might need to think of it as something that doesn't have parts the way a house—or even a hydrogen atom—does. Is this a coherent possibility? If something is a thing, must it not have parts, at least in principle? Or does this rule only apply to things *in* spacetime and not to spacetime itself? Quantum physics seeks to quantize spacetime (and, thereby, hopefully also quantize gravity). But so far no agreement has been reached on how that would work.

In considering spacetime realism, perhaps the most important question is whether capturing reality is actually the point of physics. We have seen that a typical interpretation of relativity treats spacetime as an entity in its own right. **Scientific realism** is the view that successful scientific theories are to be taken literally: The entities that they describe, both the observable (like comets or three-toed sloths) and the unobservable (like electrons or spacetime), are to be taken to truly exist as described.

The alternative to scientific realism is called **scientific instrumentalism**. On the instrumentalist view, the physical sciences are essentially pragmatic, in that their purpose is just to help us systematize observations and predict events as we know them (and only as we know them). Our physical theories are conceptual and/or mathematical models of nature that are meant to represent the world for purposes of explanation and prediction, but do not involve claims

to literal knowledge of basic, unobservable entities, forces, and relationships. Many prominent physicists are instrumentalists. In *A Brief History of Time,* Stephen Hawking offers a modest understanding of scientific theorizing as model-building:

> [A] theory is just a model of the universe, or a restricted part of it, and a set of rules that relate quantities in the model to observations that we make. It exists only in our minds, and does not have any other reality (whatever that might mean). A theory is a good theory if it satisfies two requirements: it must accurately describe a large class of observations on the basis of a model that contains only a few arbitrary elements, and it must make definite predictions about the results of future observations.

In a recent essay, physicist N. David Mermin takes a corresponding position on the reality of spacetime:

> The raw material of our experience consists of events. Events, by virtue of being directly accessible to our experience, have an unavoidably classical character. Space and time and spacetime are not properties of the world we live in but concepts we have invented to help us organize classical events. Notions like dimension or interval, or curvature or geodesics, are properties not of the world we live in but of the abstract geometric constructions we have invented to help us organize events.

In *From Eternity to Here,* Sean Carroll's 2010 book on the physics of time, Carroll agrees and discusses the implications for temporal concepts:

> Perhaps surprisingly, physicists are not overly concerned with adjudicating which concepts are 'real' or not. They care very much about how the real world works, but to them it's a matter of constructing theoretical models and comparing them with empirical data. It's not the individual concepts characteristic of each model ('past,' 'future,' 'time') that matter; it's the structure as a whole. Indeed it often turns out to be the case that one specific model can be described in two completely different ways, using an entirely different set of concepts.

Whether we take physicists' pronouncements about the nature of space and time literally depends on the extent we take objective reality to be the subject matter of physics. The right answer to this will likely be nuanced and may require a modest interpretation of physical theories.

Certainly, the above statements each fall short of saying that what constitutes an acceptable scientific theory is a merely subjective matter. Note Carroll's confident reference to the "real world". Dispensing altogether with the notion of an objective reality somewhat accessible by science would make any physical theory's predictive power an inexplicable miracle. Reality, though only imperfectly grasped via observation and inference, constrains our selection of one theory over another; a scientific instrumentalist just concedes that any representation of reality is inescapably mediated by our perceptual faculties and ways of thinking. Some descriptions of the universe remain truly and demonstrably better than others because they explain more of what we see and permit more accurate predictions about future observations.

In the macroscopic (non-quantum) world the theory of relativity purports to describe, it is extremely well confirmed. One standard interpretation of relativity treats spacetime as a real matrix

for events. We may therefore say that spacetime realism is a good assumption because it comports well with our observations. Can we go ahead and conclude that spacetime is indeed real? We must retain modest expectations regarding a definitive answer to this question, no matter what advancements in our knowledge may lie ahead.

One question we can fruitfully investigate further is the highly contentious issue of the *passage* of time. Remember that, for the temporal realist Newton, the essential and definitive property of time is its "regular and equable flow". Flow? A flow of what? Rivers flow. Rivers flow because water flows. But what flows when time flows? In twentieth- and twenty-first-century philosophy, much attention has been focused on this notion of the alleged movement of time itself. The passage of time is really the aspect of time that means the most to us in our day-to-day lives; this is where the study of the nature of time and the study of the experience of time come together.

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Chapter 4

Does Time Pass?

Classically, the definitive property of time is that it passes, or flows. The alleged passage of time is intimately bound up with the notion of a real past, present, and future, because the passage of time is the change that occurs as events go from being future to being present to being past. But we have seen reasons to doubt that events really have the objective properties of being past, present, or future. Is the passage of time real?

REASONS TO THINK NOT, PART ONE (LOGIC)

The metaphor of a river of time is often employed to illustrate the idea of the alleged flow, or passage, of time. Even as a metaphor, this image is a little unclear. Are we standing on the riverbank, watching events be carried along; or are we traveling on the river and experiencing stationary events as we pass by them? The distinction between these two visualizations doesn't seem to make any real difference. Correspondingly, the use of a term like "flow" or "passage" is ambiguous when applied to time: It can refer to how events seem to change, in that they could be described as progressing 'backward' from future to present to past; alternatively, we could say

A Brief History of the Philosophy of Time. Second Edition. Adrian Bardon, Oxford University Press.
 DOI: 10.1093/oso/

that changes in our experience depend on a sort of moving now—a unique present that constantly and fluidly moves 'forward' into the future.

Either way, the notion of the passage of time is closely tied to that of change. It was changes in existence, events, and properties that Parmenides of Elea called an incoherent fiction. Parmenides argued that the notion of change over time presupposes a real future that becomes present, and a present that becomes past—that is, a flow or passage of time like the one posited by Isaac Newton. But we have seen that some of Newton's ideas about time have been undermined by post-Newtonian developments.

In 1908, about the time Einstein was publishing his original series of breakthrough papers on the relativity of motion, space, and time, English philosopher and temporal idealist J. M. E. McTaggart produced a detailed argument for the unreality of time that built on Parmenides' original argument for temporal idealism. This argument has been a big topic of discussion for philosophers ever since.

Like Parmenides, McTaggart believed that the reality of time is predicated on the reality of change, where change is understood as involving the passage of time. Let us call the theory according to which passage is a real aspect of events the **dynamic theory** of time (aka the "A-theory", for reasons we shall see shortly). The dynamic theory really couldn't seem more natural or intuitive. It incorporates the idea that there is something special about the *now*, the present moment. This moment—the moment you are experiencing right now—is special, in that it picks out what is really going on, as opposed to what merely was or will be happening. This moment is also changing, in that, even as we speak, it is replaced by a new now. Future events are coming to pass, even as what just happened fades into the past. Time passes, and, so to speak, there is no time like the

present. This change in time is what change is all about; and the reality of dynamic change is, it seems, undeniable.

McTaggart's argument against the dynamic theory is logical as opposed to empirical. As he explains, there are two ways of understanding the ordering of events in time: in terms of the changing, nonrelational properties of being "past", "present", and "future"; and in terms of the unchanging relations "earlier than", "simultaneous with", and "later than". The former series (McTaggart calls it the **A-series**) is dynamic: Events are future, then they become present, and then past. A-series change is measured by clocks. Events change with regard to whether they are future, present, or past; and they change as to the degree in which they are future or past (i.e., over time, they become less future or more past). Tonight's basketball game goes from being thirty minutes away, to five minutes. The game lasts two hours. Then it is past and done with. In this way, the dynamic theorist is committed to events having the intrinsic temporal properties of pastness, presentness, and futurity, which they lose or gain over time. A commitment to seeing time in terms of the A-series is integral to the theory that the passage of time is a real phenomenon.

The other time series (the **B-series**) refers to the sort of information you could get from looking at events recorded on a calendar: You would learn the dates of these events, and you would know which ones come earlier than others, which come later, and which come on the same date. This kind of relation between events does not change over time; if an event is at any time simultaneous with, earlier than, or later than another, then it is always so. On a Western calendar, New Year's Day 2025 falls on January 1 of that year. It comes after the 2024 autumnal equinox and before the 2025 spring equinox. This very set of relations holds true regardless of what day it is today, or even what year it is; this set of relations holds

true in 1994 and in 2044. For a B-series theorist, genuine temporal properties have only to do with timeless B-series relations, rather than with any changeable properties, like presentness, that events have in themselves. This kind of theorist is a realist about temporal relations and the order of time, but an idealist about the passage of time (i.e., affirms the reality of B-series relations but denies the reality of A-series properties). This is the **static theory** of time (aka the "B-theory"). Consequently, we now have an important distinction between two kinds of realist: the A-theorist, a temporal realist who believes in dynamic change and the flow of time; and the B-theorist, a temporal realist who denies the flow of time and accepts change only in the sense that things are different at different times.

It is on the reality of A-series temporal properties that the reality of the passage of time rests. So the key question is, are we justified in saying that some events are really present (and some really past, and some really future)? Wouldn't you be missing some really important information, the dynamic theorist would insist, if you didn't know what time it is *now*?

Parmenides claimed that when we say an event is future, or present, or past, we have unwittingly committed ourselves to saying that that event is future, present, *and* past. But these temporal determinations are incompatible. Ascribing each of these determinations to each event would also lead to other nonsense, such as the conclusion that Napoleon Bonaparte is both alive and not alive, and dinosaurs both walk and do not walk the earth.

The natural response to Parmenides is that any actual event does have each of these contradictory determinations, but only at different "times". Events can be present in the present, present in the past, or present in the future; they can also be future in the present, past in the future, et cetera. At one time Napoleon is alive and at another he is not; whether the statement "Napoleon is alive" is

true depends on when the statement is made. After his death, we change the verb tense we are using, in describing his state of aliveness, from "is" to "was". Our use of tenses reflects our commitment to the objective reality of A-series properties, in that it is changes in the A-series properties of things that make changes in the verb tense of a declarative statement like "Napoleon is alive" appropriate. The truth of the resulting tensed statement depends on the A-series situation (i.e., whether Napoleon is alive in the present, or only in the past). The problem with this answer, as McTaggart argues, is that it merely relocates the Parmenidean contradiction to the next level. Every state of affairs is future in the future, future in the present, *and* future in the past. At different times, each state of affairs bears each of these contradictory determinations. And so on for any attempt to further specify times at which events bear temporal properties. Should the dynamic theorist be concerned about the endless new contradictions that arise at every higher level of A-series specification?

Here's another way of putting the question. The **truth conditions** for a statement are the conditions that must be in place for that statement to be true. If I say, "An ocelot is in the room", that statement is true if and only if there is an ocelot presently in the room. The truth condition for my claim that an ocelot is in the room is the presence of an ocelot in the room *now*. A-series theorists are committed to tensed statements being made true by A-series facts. They are committed, in other words, for the truth of a statement like "S is the case" to depend on the fact that S is *present*.

Effectively, McTaggart is pointing out a problem regarding the truth conditions for any statement that involves the use of tenses like "was", "is", or "will be". Can the proponent of the dynamic theory explain *when* a tensed statement like "Napoleon is alive" is true, drawing on A-series facts only? Take a future event "P" (say,

the 2036 US presidential election). Let us assume that the election will indeed take place, so the statement "P will happen" is true. But "P will happen" is not always true.[1] At any time after 2036, P will be past, so "P will happen" will not be true if uttered then. When is "P will happen" true? "P will happen" is true when P is future *in the present*.

But this doesn't fully answer the question. This reply doesn't tell you how the truth of the statement "P will happen" should be assessed, because the statement "P is future in the present", although true now, is not true at other times. After 2036, P is past in the present: At that point, "P is future in the present" is false. So " 'P will happen' is true when P is future in the present" still doesn't tell us when "P will happen" is true. We need to know when "P is future in the present" is true; and the answer depends on whether "P is future in the present" is true in the present. That statement about the 2036 election wouldn't be true when uttered in 2037, for example.

But now the problem arises yet again at the next level. Specifying that "P is future in the present" is true in the present (but false in the future) won't be enough: Now you have to specify when the statement " 'P is future in the present' is true in the present" is true, and so on. This is what is known as an infinite regress. There is no stopping point; there is no way to fully specify the truth conditions for a tensed statement just by employing A-series concepts. You can only end the regress by bringing in static, B-series locators for the utterance and the subject of the utterance: For example, "P will happen" is true *if uttered earlier than 2036*. But, you see, this means that a tensed statement can only definitively count as true or false if an utterance of such a statement is understood as an event fixed in

1. As you know very well if you are reading this book after 2036! For you, "P will happen" is false, whereas "P did happen" is true.

static calendar time. Parmenides had claimed that there is a contradiction inherent in ascribing A-series properties to events, in that every event would have to be ascribed each contradictory property; McTaggart now explains why any attempt to explain that problem away by reference to changes, over time, in the truth values of our tensed statements will just continue to generate new contradictions ad infinitum. Parmenides' whole point was that the way we intuitively talk about time and change pulls us in both directions, and there is no way to resolve the contradictions internal to passage talk. McTaggart basically just shows why tenses don't relieve the tension. If temporal properties like past, present, and future are real, then every event bears every temporal determination—and any attempt to explain away the contradiction at any level gives rise to a new contradiction. The only way to describe the world without this regress is to describe it in static calendar terms.

We have defined the passage of time as the movement of events from future to present to past. If talk about the past, present, and future gets us into an infinite regress, such talk is, arguably, conceptually incoherent. McTaggart concludes that the notion of the passage of time is incoherent.

There are other odd consequences of supposing that certain events really have the property of being past, present, or future. Take some past event like the Battle of Waterloo. One would think that past events, being over and done with, should not be susceptible to further changes. Yet, as philosopher Ulrich Meyer points out, it is a consequence of the dynamic theory of time that something very odd is happening even now to the Battle of Waterloo: It is becoming *more past*. If we insist on the reality of A-series properties, this conclusion seems inevitable. But how can a past event be changing now? This is another reason to wonder, with Parmenides and McTaggart,

if we are not systematically confused, in our day-to-day lives, about the reality of the passage of time.

Like Parmenides, McTaggart thought that the only alternative to dynamic theory is full-on temporal idealism. The static theorist, or B-theorist, thinks that we can speak in terms of an unchanging but distinctively temporal order of events even without the flow of time. McTaggart argued that, without the passage of time, there is no temporal direction or dimension that would explain why we could or should describe events with the relational temporal ordering properties "earlier than", "later than", and "simultaneous with". There is an order of events out in the world, but that order is like the order of, say, the letters in the English alphabet. We are used to reciting the letters from A to Z, but there is no fundamental fact about the letters making up the alphabet that means that they truly belong in that order. We could equally well recite them from Z to A without losing any information. According to McTaggart, the events that make up the world's 'timeline' are real, but their *temporality* is entirely mind dependent. He called the real but atemporal series of events the **C-series**, making McTaggart a type of temporal idealist sometimes called a "C-theorist".

Defenders of the dynamic theory have explored some options in response to McTaggart. Perhaps the most popular such option is called **presentism**, according to which present events absolutely exist but past and future ones absolutely do not. The present constantly changes, and time thereby passes, but there is no sense in which past and future events have any current status. Parmenides' dilemma was that we talk about the past and future as both existing and not existing. The presentist resolves this dilemma by embracing one side of it and dispensing with the other. For the presentist, only the present moment exists. We live in an ever-changing *now*: The past exists only in our memories, and the future only in our

imagination. But the present moment and its contents are currently happening and objectively real. Changes in the present constitute the mind-independent flow of time. As Parmenides had pointed out, it is natural, much of the time, to contrast the actual presence of the present with the nonexistence of the past and future: The past is gone and the future is not yet. The present moment is special; after all, we can be directly aware of what is happening now, unlike what happened in the past and what will happen in the future.[2] Only what is now is what is. The presentist denies that a commitment to flow and change means we are also committed to treating events in the past and future as real. If so, then the contradictions McTaggart finds in the dynamic theory of time don't arise; what is true is simply what is true now and not at other times—because other times don't exist.

Unfortunately, it is not at all clear that presentism is viable. No matter what presentism says, we are committed, in our ordinary manner of conceptualizing time, to the reality of the past and future. According to the presentist, a past object or being, such as Napoleon's horse Wagram, does not exist. Yet we seem perfectly able to speak meaningfully about Wagram the horse, such as when we describe its color and size. What are we referring to, if not to Wagram? The B-theorist can explain how we can refer to Wagram because *Wagram exists in 1809*. The presentist has no easy answer to this objection: The otherwise perfectly natural response that Wagram *existed* in 1809, but no longer, exposes the presentist to McTaggart's concerns about an infinite regress of unspecifiable truth conditions for tensed sentences.

Consider further any true statement about the past, such as that the Berlin Wall fell in 1989. What makes this statement true?

2. It is true that the information we are aware of at a given time is not entirely current, in that the limited speed of light and sound means that what we are now experiencing are events that happened some time ago. However, we can at least think of the arrival and processing of information as something that is happening now-ish.

Presumably, a fact about what happened in 1989. The presentist can't consistently agree to that, though, because presentism doesn't allow for the reality of events that aren't happening now. The fact that people *now* have memories of the incident, or that there are *now* piles of concrete rubble where the wall is said to have been present, doesn't make it true now that the wall fell in 1989—or that it ever existed, for that matter. Rather, only the event of its falling in 1989 makes it true now that it fell. Insofar as we can make true statements about the past, it must be false that only the present exists. This is why Parmenides said we are committed to the reality of non-present times (even as we are also, inconsistently, committed to their unreality).

And, by the way, how long is the present? According to presentism, only the present exists. Is that the present minute? This second? Half a second? Part of the present second is past, and part future. And so on for any smaller time period you might care to name. Any so-called present moment would appear to be infinitely divisible into further segmentations. The present can't literally be an instant; durationless infinitesimal moments are mere mathematical abstractions, and nothing real can be composed of such things. Aristotle and Augustine both rejected the independent reality of moments, or 'nows', partly on this basis. There is no non-arbitrary way to pick out what is meant by the uniquely true and real present moment.

Finally, presentism appears to be self-defeating as a defense of the possibility of change. Recall Zeno's motionless arrow. The paradox of The Arrow stated that, at any instant, any object is at rest; if time is composed of such moments, then no object is ever in motion. The standard response is that time is not composed of infinitesimal moments, and that motion is motion over stretches of time. But this answer is not available to the presentist. There are no other times,

according to the presentist, so motion can only be a matter of what is happening now. Zeno's challenge showed that any adequate analysis of motion, or any other sort of change, must refer to times other than the present instant. This brings us back to Parmenides'claim that, if we believe in dynamic change, we are thereby committed to a real past and future. Presentism abandons change in an attempt to save it.

Other dynamic theorists have proposed a couple of alternatives to presentism: **growing block theory** and **moving spotlight theory**. According to growing block theory, the present is the leading edge of an expanding block of existing past and present events. (Or—probably better—the world just grows temporally tout court.) Moving spotlight theory holds that all events exist, but only a (changing) set of them have the special status of presentness—as though progressively illuminated by a moving spotlight. Neither the growing block nor the moving spotlight are workable. On the growing block model, what is the difference between past events (including past experiences) and those privileged present ones on the leading edge of the growing block? How would one know one's current experience is taking place in the present rather than in the past? What time is it in the present? Looking at a clock doesn't help because people in the past look at clocks too. The moving spotlight theory postulates that all non-present events exist in some sort of mysterious state of hidden being without being present to anyone. The basic problem with this theory is similar to the problem with growing block theory: How are non-present events in this scenario unlike present ones? Human experience happens at many of these other, hidden moments; but, one supposes, such experience is non-present, unilluminated experience (whatever that means). So, which type of experience are we having right now—the illuminated kind or the unilluminated? There are many more problems with the

growing block and the moving spotlight,[3] but suffice it to say that neither performs any better than presentism against Parmenidean concerns.

The failure of attempts to rescue the dynamic theory of time from the problem of conceptual incoherence doesn't mean that we must conclude, with idealists Parmenides, Zeno, Augustine, Kant, du Châtelet, and McTaggart, that reality lacks any inherent temporal dimension. An alternative to the A-theorist's dynamic theory of time is the B-theorist's static theory, which rejects the objective reality of A-series properties, but embraces the reality of an order of time that includes unchanging B-series temporal relations (i.e., earlier than, simultaneous with, and later than). According to the static theory of time, the fall of the Berlin Wall temporally precedes, say, the 2036 US presidential election. It always has preceded it, and it always will precede it; temporal relations between events do not change. Events do not come and go, yet they do exhibit temporal relations—relations, that is, of the B-series sort. An order of time exists, according to the static theory, but dynamic change—change involving the passage of time—does not. The static theorist believes in change, but only understood in a way that does not commit one to the passage of time: On the static theory, change is to be understood as referring merely to the world being timelessly one way at one moment and timelessly another way at a subsequent moment.

According to the static theory, "past", "present", and "future" are subjective terms valid only for that moment and that person. Static theory treats temporal location much like spatial location. The temporal location of "now" is just as much a personal matter as the spatial location of "right here" or "over there". No object is really 'here'

3. Most importantly, presentism, growing block theory, and moving spotlight theory all suffer from the uselessness of an absolute present under relativity (see the next section).

or 'there'; it just is where it is. Similarly, no event is really now. All events exist timelessly in an eternal, unchanging temporal order. This, the static theorist's view of existence, is called **eternalism**, in direct opposition to presentism. The advantage of this theory of time is that it avoids the contradictions inherent in the notion of temporal properties that change over time, while preserving our sense that time is real and events are ordered in time.

Eternalism brings with it an interesting view of physical objects enduring over time: **perdurantism**. From the perdurantist viewpoint, a physical object is not wholly present at any moment in time. Rather, objects are extended in spacetime, like four-dimensional worms, with only a part of them, or spacetime slice, existing timelessly at any moment of their existence. This would apply equally to human beings. As odd as this sounds, upon examination perdurantism makes more sense than any account of personal identity over time derivable from the dynamic theory. The dynamic theory implies that we exist in our entirety at any time, even as time passes. For any existing person, there is a present self, many past selves, and, potentially, many future selves. But they are all the same person, just at different times in his or her history. Each self at each time is a whole person, distinct from all those related selves at other times, and yet also identical to them. The reality of the passage of time would mean we both are and are not identical to ourselves at other times.

REASONS TO THINK NOT, PART TWO (PHYSICS)

Static theorists believe in change in the sense that things are different at different times. Change is real, but the passage of time is not something that happens *in addition to* change. The static theory

is also sometimes called the "tenseless theory" of time. According to this theory, our use of tenses, as in "This will happen"; "That just happened"; "Napoleon was alive"; "The refrigerator is broken", is useful to us as beings who always operate from a particular perspective mediated by memory and anticipation. Tensed sentences like these just describe what things look like from one's perspective at a given tenseless moment: At one moment, I anticipate some event E; over some span of moments, I experience E; at some later moment, I remember E. That's all there is to living in time. We don't need some other process—the passage of time—to capture what it is like to experience time and change.

Dynamic theorists might reply by insisting that passage deniers—both the temporal idealist and the static realist—are failing to take the fundamentality of A-series properties seriously. From an introductory text on metaphysics by John Carroll and Ned Markosian:

> [T]he A-theorist's best move is to say that we must "take tense seriously." This means, roughly, that there is a fundamental and unanalyzable difference between saying that something is φ and saying that it *was* φ or *will be* φ. Taking tense seriously also means that propositions have truth values at times, and can change their truth values over time.

On this view, tenses pick out a fact about the world that is just not susceptible to the kind of regress McTaggart is worried about. Every time one asks how to understand a tensed statement, this A-theorist just refuses to allow that there is anything more to be said about the significance of an "is", a "was", or a "will be". So the alleged infinite regress entailed by attempting to specify the *when* of an event can't get started.

This is not the end of the discussion, however, because there is a very significant contribution to this debate to be made by physics. Recall that the well-confirmed theory of relativity makes simultaneity a relative matter: Two events that are simultaneous to an observer in one inertial reference frame will be non-simultaneous to a different observer moving relative to the first one. We saw this in the case of Isaac and Albert at the train station. Each has his own plane of simultaneity, encompassing those events that are simultaneous in his frame of reference. (And a third observer, in a third reference frame, will have a whole different assessment as to the spatial and temporal coordinates of these events.) Because there is no absolute motion, there is truly no objectively correct answer as to which events are really simultaneous and which are not. This means that the set of events 'present' to Isaac is different from Albert's set; each is equally justified in identifying his set as present. This also means that neither would be justified in identifying a particular moment that everyone should agree is the present moment. The same goes for pastness and futurity: An event Isaac considers past may be present, or even future, for Albert, depending on its relative distance and their relative velocity (see figure 4.1).[4] If there is no reason to propose a privileged vantage point from which to determine the truth of the matter—and the whole point of relativity is that there is not—then temporal properties like past, present, and future cannot possibly be aspects of reality as it is in itself. They *must* be perspectival in nature, indexed to a particular observer at particular spacetime coordinates, traveling a particular spacetime path.

4. Figure adapted, courtesy of Wikipedia user Acdx, based on file Relativity_of_Simultaneity.svg. Accessed October 22, 2012, at http://en.wikipedia.org/wiki/File:Relativity_of_Simultaneity_Animation.gif.

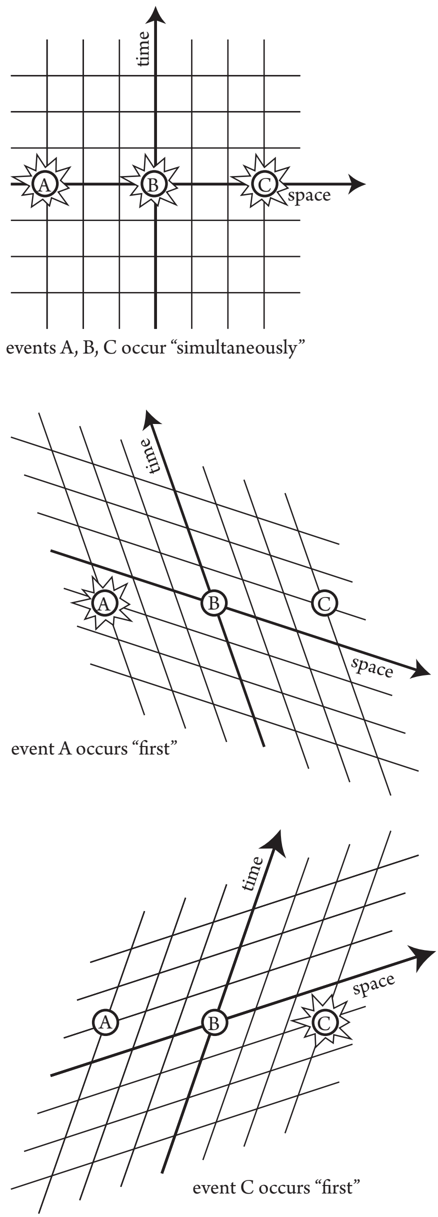

Figure 4.1. The perceived orientation of spacetime, and thus the perceived order of events, depends on one's relative velocity; this means that what events are present is also a relative matter.

If the theory of relativity is correct, then—as strange as it may sound—the dynamic theory of time is completely unmotivated from a scientific perspective.[5] At any moment, all events, past, present, and future, are each present according to some reference frame. None are special in themselves. There is no objective past, present, or future. Without a real past, present, and future, there can be no passage of time and no dynamic change.

The static theory of time is bolstered by further reflection on the very notion of a real passage of time as a process unto itself. The image of a flow of time implies a sort of movement: Events 'move' into the past and we observers 'move' into the future. In every other context, when we talk about movement or change, we are talking about movement or change *over time*. But what about the claim that time itself is passing? Time is passing relative to what? To time? How could time pass with respect to itself? Further, if time passes, at what *rate* does it pass? Normally, we think of things in a state of change or motion as having a rate of change or motion: for example, kilometers per hour, beats per minute, or revolutions per second. How would the rate of the passage of time be described? "One second per second" is not a rate: It communicates no information. Even without talking about relativity, none of this 'flow of time' stuff makes any sense when you actually think about it.

Does this mean Parmenides and the idealists were right all along? The logical and physical contradictions inherent in the notion of

5. As explained by historian of science Jimena Canales, prominent French philosopher Henri Bergson publicly disagreed with Einstein, insisting that the natural sciences cannot capture or alter our understanding of time as lived experience. Einstein famously responded by stating that "the time of the philosophers does not exist." As the debate continued, Bergson did not help his case very much by making claims that seemed to indicate a gross misunderstanding of time dilation in relativity.

dynamic change only tell half the story. Parmenides denied not only the objective reality of change, but also the very existence of time itself. As we saw in the last section, there is a realist theory—the static theory of time—that rejects the objective passage of time but preserves time as an order of events, with objective temporal relations between events. Does the relativity of simultaneity imply that the static theory of time is also wrong?

The static theorist maintains that B-series relations are fixed and unchanging—temporal properties are what they are, so to speak, eternally. Relativity permits observers in every reference frame to agree on the temporal order of events within any specific light cone. Earlier-later relations remain fixed within any particular perspective as defined by a spacetime path. This permits us to speak of fixed temporal sequences of events, even when taking relativity into account.

How should we represent or imagine a world with time-ordered events, yet without the passage of time? Static theorists sometimes refer to the world of unchanging events in spacetime as a relativistic **block universe**. This refers to the notion of a four-dimensional block depicting everything happening in space over time. (Note that the relativistic block universe is not growing: All determinate events in spacetime just exist.) It's a tricky image because observers in different reference frames will produce different, equally valid representations of the block; that is to say, they will assign different spatial and temporal coordinates to events. In a *Newtonian* block universe, all events would exhibit a single set of B-series relations that are the same for all observers. In contrast, that is only true in Minkowski spacetime within a given frame of reference (as illustrated, in chapter 3, by light cones and the proper time of a hypothetical observer). For example, take observers Isaac and Albert, moving rapidly relative to one

another. Isaac orders a series of events A-B-C-D (within one light cone) and a series of events E-F-G-H (space-like separated from A-B-C-D) as follows:

> A and E occur simultaneously,
> then B and F occur simultaneously,
> then C and G occur simultaneously,
> then D and H occur simultaneously.

But Albert may, with equal authority, locate them as follows:

> A occurs,
> then B occurs,
> then C and E occur simultaneously,
> then D and F occur simultaneously,
> then G occurs,
> then H occurs.

This illustrates how observers in different reference frames may disagree about ordering with regard to space-like separated events yet can agree on a temporal ordering for merely time-like separated events. This implies a fixedness with regard to time relations within a given light cone; and, because causality can only function within light cones (because nothing travels faster than light), from the standpoint of a physical description of the operation of natural laws, the earlier-later relation is meaningful and useful.

Relativity permits us to identify objective B-series relations between any causally relatable events. It is in this sense that, despite the relativity of simultaneity, the static theory of time allows real

temporality in the sense of objective and unchanging earlier-later relations.

Certainly, the terms "past", "present", and "future" are extremely helpful. The attribution of beliefs drawing on these concepts is indispensable in explaining and predicting human behavior. The subjective designation of something as past, present, or future is extremely meaningful from the perspective of a particular, unexceptional observer at a particular, unexceptional moment. But such designations have no role to play in an objective representation of the distribution of events in spacetime. Take someone drinking a cup of coffee. Explaining her action involves, in part, ascribing to her the belief that her cup of coffee is "here". She reaches across the table for some sugar. Explaining that action involves, in part, her belief that the sugar is "there". But *here* and *there* are merely subjective designations; for someone at the other end of the table, it's the sugar that would be "here" and the coffee "over there". There is no objective, third-person standpoint with respect to which the coffee cup is truly here or there. Just like "here", "now" is a term that has no application in a description of the world that excludes people's subjective beliefs and attitudes at a specific moment in their timeline. To include "now" in that description would presume an absolute present that relativity dispenses with when it dispenses with absolute simultaneity. (Furthermore, if and when the theory of relativity is folded into a more complete quantum theory of physical reality, this core aspect of relativity will almost certainly remain unaffected.) The result, under the realist static theory, is a universe of all events each having equal status at all times equally as past, present, and future—which is to say, having no such status at all. All events just BE, temporally related only by BEing earlier than, concurrent with, or later than each other.

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Chapter 5

The Persistent Projection of Passage

Despite it all, many would continue to insist that there just *must* be something to the idea of the passage of time. The sense of an inexorable movement of and through time seems like an obvious and ineliminable aspect of our lived experience. It's not enough just to point out deficiencies in the dynamic theory of time. The static theorist needs to explain how and why just about all of us have been getting it so wrong.

IS THE PASSAGE OF TIME AN ILLUSION?

Philosopher Michael Dummett (among others) has argued that, even if you wanted to deny the passage of time, you still would need to explain the *illusion* of the passage of time, in the form of changing attitudes toward events according to whether they are perceived as future, present, or past. But how can you explain the illusion of such change except by reference to dynamically changing apprehensions on the part of the victim of the illusion? Then you have dynamic change again: If you can't explain the illusion of change without

A Brief History of the Philosophy of Time. Second Edition. Adrian Bardon, Oxford University Press.
 DOI: 10.1093/oso/

reference to dynamically changing apprehensions, then you haven't successfully taken the passage of time out of the equation.

In a 1937 book, British logician and philosopher Susan Stebbing claimed a "direct experience of 'becoming'", concluding that "consciousness is directly aware of the succeeding of one event by another event." Philosophers Peter van Inwagen and Donald Williams have referred, respectively, to the "sensation of temporal motion", and to the "felt flow of one moment into the next". Physicist Paul Davies has spoken of "the sensation of a flowing time and a moving present moment". Philosopher M. M. Schuster asserted that "the flow of time, or passage, as it is known, is given in experience, that it is as indubitable an aspect of our perception of the world as the sights and sounds that come in upon us". It is becoming less common, but it is still possible to find a few scholars who claim to know that time really flows by virtue of a direct experience of that flow.

Well, if there were such an experience, this would constitute direct empirical evidence for the passage of time. But do we really sense the passage of time?

It's understandable why people might be led to make this sort of report. We don't typically perceive dynamic processes as a mere succession of atomic snapshots. Our experience of motions and other continuous events seems to have a certain quality that is not fully captured by our simply having successive beliefs about part of the motion or process being future, present, and then past. As we discussed in chapter 2, seeing something in motion is not the same thing as remembering it as having occupied different locations at different times; listening to a melody is different from just hearing different notes occurring in sequence. This was Sean Kelly's phenomenon of "pace perceived".

Kelly views the explanation of the phenomenon of pace perceived primarily as a challenge for neuroscience. Unlike some processes (for example a clock's ticking second hand), much of the movement or change we experience is smoothly continuous. Somehow the brain converts discontinuous sensory inputs into "experiences as of continuous, dynamic, temporally structured, unified events." Our experience 'flows' in the sense that the perception of movement or change is typically experienced as an ongoing continuity rather than as an accumulation of static moments. However, the experience of continuous change is not the same thing as having a distinct feeling of the flow of time. As philosopher Natalja Deng has stressed, the static theorist is not committed to all, say, visually perceived motion being constituted by a mere series of static images. A rapidly flickering filmstrip passing through the projector in a movie theater can give us the impression of continuous motion. But life is not a series of still movie frames. Continuous motion is not an *illusion* except in specific cases like phi motion (i.e., the impression of spatial motion created by rapidly alternating images, as described in chapter 2). The static theorist believes in motion and succession—including continuous, uninterrupted succession; the static theorist only denies that there is some *other* process of flow happening in addition to that succession. There is no need to explain away the 'illusion' of our experience of flow: The experience of continuity and succession is all there is. There is no illusory phenomenal experience of flow; flow is a fiction but not an illusion.

Temporal **deflationism** is the view—consistent with static theory and increasingly dominant in philosophy of time—that we not only do not experience the passage of time, but do not even *seem* to experience the passage of time. According to deflationism, the

idea that we have an experience as of the passage of time is a conceptual confusion—a misrepresentation of the nature of one's own experience.[1]

A deflationist account of belief in the passage of time is to be distinguished from an account (let's call it temporal **illusionism**) according to which our belief in the passage of time is based on an illusion. An illusion, by definition, involves a false appearance or misleading impression of reality. Basically, with an illusion there is some tricky or ambiguous input, perhaps combined with some misleading contextual cues, which leads to a misperception of what is really going on. For example, in the Müller-Lyer illusion a pair of lines of the same length appear to be of different lengths; under confusing lighting conditions a blue dress may appear white; the condition known as tinnitus involves the perception of a ringing sound when no external source for such a sound is present.

In experience, we are presented with all kinds of input whereby we experience shapes, colors, sounds, and motions. Some of these inputs, in context, may be veridical and some may be misleading. But there is no aspect of our experience whereby, in addition to all our other sensory inputs, we are *also* presented—either truly *or* falsely—with an additional 'flow of time' sensation. What we do experience are a series of states of the world that our brain stitches together into the experience of continuous motions and changes against a background of enduring objects. The other main piece to the puzzle is the fact that we conceive of ourselves as enduring subjects of experience persisting through changes in the world around us. As philosopher Jenann Ismael has observed, at every moment we employ experience and memory to self-localize in space and time in what

1. Some of the following material is derived from my essay "The Passage of Time Is Not an Illusion: It's a Projection", *Philosophy* 98 (2023), 485–506.

seems like a continuous process. This process of self-localization has an apparent direction because memory and knowledge only accumulate with regard to 'past' events, while anticipation and agency are directed toward the 'future'. We consequently self-represent as enduring agents moving through time and experiencing a world of dynamic changes. We never actually *experience* a dynamic world; rather, we *conceive* of the world as dynamic because of the way we conceptualize our own relationship to different states of the world. If we go on to report that we experience a distinct, dynamic flow of time, it is only because of the way we think about our relationship to time in the first place.

Together with psychologist Alex Holcombe, Australian philosophers Kristie Miller and Andrew Latham discuss a famous 2001 experiment in which investigators asked a panel of fifty-four professional wine tasters to assess the smell of white wine that had been secretly dyed red. The dye was odorless and did not change the smell of the wine. Yet the wine tasters largely responded by describing the *smell* as that of red wine. What we seem to have here is a case where the tasters misrepresented their own olfactory experience because they believed they were dealing with red wine. There was no illusory sensory input when it came to the odor; their characterization of their own phenomenology would thus be better described as resulting from cognitive misrepresentation rather than perceptual illusion. This is what we would call a "deflationist" account of the tasters' olfactory experience.

Miller, Latham, and Holcombe suggest (and I agree) that belief in temporal passage works the same way: A naive conceptualization of the world as including a real passage of time leads one to misrepresent one's own experience as including a *sense* of the passage of time.

Assume we live in the static, four-dimensional block universe of relativity. Different things happen at different times. At any moment we experience certain things, remember certain things, and anticipate certain things. At a later moment we remember more, while our brains continue stitching together different inputs—present and past—into continuous scenes of a world around us that includes enduring objects, changes, and motions. Is anything missing from this story? Let's say we add to this universe something else: a flow of time. How would our experience be any different? Nothing in our experience would be different: color would be color, sounds would be sounds, objects would be objects, motion would be motion, change would be change. This 'flow of time' would be a completely extraneous, unnecessary addition to the story of one's lived experience of a static block universe of events.

The alleged felt passage of time does not require any corresponding objective phenomenon along the lines of Newton's "regular and equable flow" of absolute time. (Newton's physics didn't even require it, really.) Nor does it require an illusory experience of the passage of time. In any event it is difficult to understand what the experience of a real flow of time would even amount to. We all know what a cool breeze feels like, or a sweet dessert. We sense the acceleration of a car. We experience key changes in a piece of music. We fondly recall our childhood; we uneasily anticipate old age. What does time *itself* feel like in addition to all that? Nothing.

CHALLENGES FOR THE STATIC THEORY

And yet, for all the arguments of philosophers and physicists, the notion of giving up on dynamic change and the passage of time feels not only wrongheaded but impossible. The primary reason for this is

the way the difference between past, present, and future is wrapped up in deep-seated psychological and emotional attitudes universal to human beings. For example, static theory eternalism entails that a deceased loved one unceasingly BE alive at an earlier time: In a static block universe, all our loved ones exist finitely yet eternally at the times at which they timelessly exist. But knowing that the static theory of time is true doesn't make the loss of a loved one any less painful. Albert Einstein famously pretended otherwise; in reference to the death of his old friend Michele Besso, Einstein wrote:

> Now Besso has departed from this strange world a little ahead of me. That means nothing. People like us, who believe in physics, know that the distinction between past, present, and future is only a stubbornly persistent illusion.

As much as Einstein may have intellectually grasped the truth of this view about time, could he truly have derived much comfort from it upon the loss of a friend? If so, he was surely one of the only people ever to do so. For the rest of us, in such cases, the disconnect between what one knows and what one feels is striking.

When it comes to how we view the past vs. how we view the future, there is a bedrock emotional asymmetry. As Louise Heath put it in her 1936 text, "In our estimates of value we incline to consider the later experience as more important than the earlier, a preference for the present over the past, but also for the future over the present." From either a negative or positive value perspective, the past is past, and the present and/or future feel like they have quite a different significance. We fondly remember (or regret) past events, while we eagerly anticipate (or fear) future events. There doesn't seem to be any way to translate expressions of such attitudes into

static, tenseless, B-series talk. New Zealander Arthur Prior, the important temporal logician, made this point as follows:

> One says, e.g., "Thank goodness that's over!", and not only is this, when said, quite clear without any date appended, but it says something which it is impossible that any use of a tenseless copula with a date should convey. It certainly doesn't mean the same as, e.g., "Thank goodness the date of the conclusion of that thing is Friday, June 15, 1954," even if it be said then. (Nor, for that matter, does it mean "Thank goodness the conclusion of that thing is contemporaneous with this utterance." Why should anybody thank goodness for that?)

It seems nonsensical to suggest that our statements involving past, present, and future could or should be rephrased in terms that don't involve changing temporal determinations. Among other things, this would require us to admit that our feelings of relief, regret, fear, and hope are entirely misplaced. In Kurt Vonnegut's novel *Slaughterhouse Five*, the protagonist comes to experience his whole life timelessly; he begins to appreciate that all the events in his life simply BE, rather than come to be and pass away. This instills in him a sense of peace in thinking both about missed opportunities during the early parts of his life and his own death at the other (timeless) end of his existence. But life isn't like this. This isn't the way we actually experience things, so having different attitudes with regard to past and future events seems inevitable.

Denying the reality of change seems to involve denying the legitimacy of what would otherwise seem to be perfectly normal emotional attitudes; some have gone further by arguing that denying the passage of time is literally incoherent. Israeli philosopher Yuval Dolev argues that our attitudes and sentiments are essential to fixing

the *meaning* of "past", "present", and "future", so asking whether attitudes toward past, present, or future conditions are rational or appropriate is based on a confusion: According to Dolev, the future, for example, just is that which we have an anticipatory attitude about. If so, then anticipation can't be wrongheaded in the way the static theorist might claim. Dutch philosopher P. J. Zwart claims that even questioning the reality of the passage of time is self-defeating: How, he asks, can the question itself be articulated except in time? Can any question be meaningfully asked or understood without presuming the passage of time from the inception of the question to its conclusion?

As we have noted, change itself takes on an attenuated meaning in the context of the static theory. In the block universe of the static theorist, change just means that the world is in one state at one moment and in a different state at a later moment. This certainly is not how we ordinarily think of change. We ordinarily think of change as involving the absolute becoming of new events and the passing away of old ones. If time does not pass, how can anything *happen*?

McTaggart thought that what the B-theorist calls "change" is more like spatial variation (i.e., differences in spatial location) than temporal variation; this is part of the reason he felt forced to conclude, with Parmenides, that change is unreal. Accepting the static theory would also mean that we would have to re-evaluate how we think about causation, natural laws, and scientific explanation. We normally think in terms of causes "bringing about" their effects, and of effects "following" their causes. Consider a law of nature, such as Newton's third law of motion, commonly summarized as "For every action there is an equal and opposite reaction." Without dynamic change and the passage of time, we are left only with a static earlier-later relationship between so-called causes and their effects. In Newton's third law, the term "reaction" seems to imply a dynamic

change because the action is said to produce a reaction that follows upon it. But on the static theory, the effect simply, timelessly, exists later than its cause. Then how can we still think in terms of active causation—of the cause bringing about the effect? The action and the so-called "reaction" just sit there, timelessly, next to each other; there may be a strong statistical correlation, in that similar actions and similar reactions are reliably found sitting side by side elsewhere on the changeless timeline; but, other than that association of adjacency, what is the *connection* between such events? We'd like to say that actions of type A and reactions of type B are connected because we only see a B after an A (under certain circumstances). We'd like further to say that, therefore, we would not have seen that B without the A preceding it. But to claim that a B's happening requires an A's prior happening is just to raise anew the question of how a B can require a prior A, if A isn't *making B happen*. On the static theory, the notion of a real connection, a causal link, between A and B seems inexplicable. Thus the static theory seems to have no room for causation as a fundamental aspect of the natural world.

Scientific investigation consists in the systematic attempt to uncover the laws that govern natural phenomena. Scientific explanation, in turn, refers to these laws in accounting for these phenomena. Imagine a very simple natural law taking the form *Events of type P are always followed by events of type Q*. We then explain why an event of type Q has taken place by noting the prior incidence of an event of type P, plus the fact that one always follows the other. The problem is that a statement of this form only qualifies as a law (rather than a coincidence) if we also believe something like *Events of type P cause events of type Q to happen*, or, perhaps, *There is some more fundamental causal law explaining why events of type P must be followed by events of type Q*. Yet, on the static theory, all we can say is that events of type P BE (timelessly) statistically well correlated with

later events of type Q. The notion of events being *brought about* by other events seems to have no place in a static worldview, so neither does the notion of a law of nature as traditionally understood.

Notions of causal explanation underlie scientific explanation. If we take the static view of things seriously (and it seems that we ought to), then events that are causally connected in our explanations are just timelessly *correlated* with each other. Without the notion of a present event that brings about a merely potential, future event, is there space for a notion of causation robust enough to ground claims to have identified fundamental physical laws? Our attempts to explain the phenomena we encounter would seem to reduce to mere descriptions of inexplicable correlations of events. In this way, the static theory might be taken to imply that reality is unknowable. If the passage of time isn't real, then we must somehow reconsider what we mean by a scientific understanding of the world in terms of laws of nature.[2]

The static theory's strange implications for causation and natural laws are mirrored by its implications for the closely related concept of probability. Ordinarily, we would think that the future is governed not only by causation but also by probability. There is a certain probability that it will rain tomorrow, or that the Dallas Cowboys will win the Super Bowl next year. But if the static theory is correct, then these events (the event of it raining or not raining tomorrow, or the event of the Cowboys winning or not winning the

2. For both Hume and Kant, this result would be viewed as a feature of the static theory, rather than as a bug. Hume famously noted that the alleged causal connections between events are not actually part of our experience of those events. He attributed our belief in causal connections to the feeling of expectation we get when we have become accustomed to types of events occurring together. Judgements about the reality of such connections outstrip what is actually found in experience. Kant thought that causation is fundamentally a matter of how we organize the raw data of experience; so the concept of causation applies only to the world considered from the human perspective, as opposed to the world as it is in itself.

Super Bowl), timelessly BE. Either it BE raining tomorrow, or it BE not raining tomorrow. Keep in mind that, as the theory of relativity indicates, what one person calls "tomorrow" is today in another reference frame. There is no question of any event being somehow merely potential or undetermined. Everything, at all times, just BE the way that it BE. So any judgment as to the probability of a so-called future event is just a statement as to our own limited perspective on timeless reality.

No wonder the static theory seems counterintuitive. The way we think about the world inextricably involves the passage of time, dynamic change, causation, explanation, probability, anticipation, and recollection. Yet our commitment to the passage of time has been called an illusion, error, or confusion since the time of Parmenides. Further, and more decisively, dispensing with the passage of time in our basic description of reality has been the seemingly ineluctable message of modern physics. As Heath says in *The Concept of Time*,

> It is interesting to note the tendency to give two definitions of time: the one dealing particularly with measurement and other problems of physics, the other referring to elements in immediate physical experience. The opposition between these two ideas is certainly made more apparent than in the earlier [historical] periods because of the greater exactness of the physical concept. . . . It seems like the appearance of two fairly distinct concepts, which had formerly been treated together because of lack of exactness, but whose difference was really implied in many of the earlier discussions.

This leaves us with the core challenge in contemporary philosophy of time: how to reconcile the centrality of the passage of time in our experience (aka **manifest time**) with the cold, hard conclusions of

logic and physics (aka **scientific time**). As we shall see in the next section, although there is work to do to achieve this reconciliation, we may be able to sketch the outlines of an eventual solution. It turns out that Kant and Darwin are equally helpful in understanding our stubborn commitment to temporal passage.

TEMPORAL PASSAGE AS ADAPTIVE PSYCHOLOGICAL PROJECTION

The solution I would like to propose is that A-series change and the passage of time are mind-dependent in the sense of being merely a matter of **psychological projection**; however, it is a projection of a special kind, in that it is conceptually indispensable to any coherent representation of the world.[3] To say a manner of representing the world is indispensable is to say that no genuinely thinkable description of the world without it is possible. This would help explain why we unavoidably include passage in our description of the world, without contradicting the conclusions of science and logic that the passage of time is a merely subjective and mind-dependent phenomenon.

The deflationist's proposal is that our conceptualization of the world as including the passage of time leads us to misrepresent our experience as including a sense of the passage of time. How can our beliefs influence our experiences? Through a well-recognized phenomenon known as psychological **projection**. As philosopher Peter Kail has explained, projection refers to a loose collection of phenomena in which one's commitment to some state of affairs being

3. Some of the material in this section is derived from my essay "Time-Awareness and Projection in Mellor and Kant," *Kant-Studien* 101 (2010).

the case is explained by psychological facts about oneself, rather than by the world really being that way. One subcategory of projection is sensory, or "feature", projection, wherein one represents an internal, subjective feeling or sensation as an objective feature of the world. An example of sensory projection is our everyday attribution of color properties to things around us, say, a red umbrella or the blue sky. Redness is not really a property that the umbrella has; rather, (a) the umbrella is reflecting light at a certain wavelength, and (b) our brains are typically constituted so as to respond to that wavelength of light in a certain distinctive way. Redness is a feeling, not a property of things. Similarly when we use adjectives like "loud". Loudness is an effect an event might have on particular sorts of listeners (ones who hear things within a certain range of sensitivity) in particular contexts (not in a vacuum, for example); it is not an intrinsic property of the event itself. Things can sound loud to us, but—regardless of grammatical conventions—it is nonsensical to propose that something literally *is* loud. In contemporary philosophical parlance, properties like redness, loudness, and smelliness are called "secondary properties". Secondary properties are not real properties of things around us, nor are they mere illusions or falsehoods: They are predictable responses to something real. Any attribution of such properties to the things causing these responses is the result of feature projection, in which a mind-dependent sensory response is erroneously (even if understandably) attributed to things independent of the mind.

As we have seen, decisive evidence indicates that the passage of time isn't really a property of the world around us. To explain why we so characteristically represent things around us in terms of a unique and dynamic present, a comparison to the projection of secondary sensory properties seems promising.

Philosopher Richard Gale disagrees, because A-series temporal determinations like pastness, presence, and futurity are not sensible qualities like color or sound. True enough, but as Robin Le Poidevin notes in response, psychological projection does not have to mean the literal thought that some particular internal sensation (like the redness of an umbrella) belongs to objects of one's experience. The perception of passage might be fruitfully compared to other sorts of projection, such as the projection of non-sensible qualities like virtue and vice. There is no real characteristic, describable by natural science, corresponding to what we call moral virtue; there are only sympathetic emotions that arise when we see patterns of behavior that we associate with pleasant results for ourselves or others. The ascription of moral virtue to persons is thus an example of psychological projection in the broader sense mentioned above, wherein one's commitment to some alleged fact about the world is explained by psychological facts about oneself, rather than by the world's really being that way.

Projection can just mean that one's assessment of the evidence of one's own experience is influenced in some way by one's beliefs. Classic examples of projection include seeing evidence of ghosts or spirits because of your beliefs about the supernatural; perception of other races or ethnicities as engaging in more criminal behavior because of your prejudices against them; or thinking that others view you with contempt because you believe yourself to be incompetent. In each of these cases, your description of the contents of your own experiences is affected by some set of beliefs you hold.

That the experience of passage is a kind of projection has been a standard view among philosophers (and physicists) since the mid-twentieth century. We experience different beliefs at different times about what is happening. It is the awareness of difference in these beliefs over time—plus the assumption that we ourselves

persist though these changes while accumulating memories—that leads us to represent events as, objectively, changing their A-series determinations. Further, the experience of smooth continuities in our perception of change and motion is confused with the experience of an objective, regular, and equable flow of time. These are not illusions. None of this suggests we are misinformed by some illusory phenomenology as to the existence of the passage of time. We are not experiencing the passage of time at all, either truly *or* falsely. These are experiences of time order, succession, and continuity; none of those things require or imply a flow of time. These are misconceptions of our own experiences, as when the wine experts misconceive their own olfactory experiences. Our *conceptions* are bleeding over into the way we construe our *perceptions*.

This deflationist account of our belief in the flow of time doesn't sit well with our intuitions. It would be rare to find someone who lacks an unassailable commitment to the passage of time, no matter what philosophy and physics might say. What makes this commitment so resistant to logic and evidence? We find hints as to an explanation in Kant. In chapter 2, we saw how Kant argued that the concept of temporal succession is presupposed in any coherent experience. His central insight was that we must impose a temporal structure on our own experience in order to make any sense of it in the first place. He started with the claim that we do not perceive time order directly; as his fellow temporal idealist Augustine also emphasized, at any given moment, all we have is our present perception and perhaps some present recollections. Yet recollection means nothing without a prior grasp of the difference between past and present. (Even on an extensionalist understanding of time perception, Kant would argue that making necessary distinctions between the parts of our extended awareness of, say, a melody would depend on those elements being understood first as deriving from

a determinately, temporally ordered sequence; otherwise the experience of the melody as a melody would not be possible.) Coherent experience, Kant argued, requires the application of an innate ability to organize the world temporally, as opposed to our deriving the concept of time from our experience (i.e., finding it in the world).

When Kant talked about organizing our experience in terms of temporal succession, he did not mean change of A-series properties; the static theory of time allows succession, albeit in static B-series terms. The distinction between dynamic change and static succession was not his primary concern. However, his theory suggests, in two respects, that the necessary conditions of human cognition involve conceptualization of the world in terms of dynamic change, the passage of time, and an asymmetry between the fixed past and an open future.

First, any complex representation typically involves a process of building up that representation over time, where a sense of the incremental construction of the representation is essential to the process. From Kant's *Critique of Pure Reason*:

> Without consciousness that that which we think is the very same as what we thought a moment before, all reproduction in the series of representations would be in vain. For it would be a new representation in our current state, which would not belong at all to the act through which it had been gradually generated, and its manifold would never constitute a whole. . . . If, in counting, I forget that the units that now hover before my senses were successively added to each other by me, then I would not cognize the generation of the multitude through this successive addition of one to the other, and consequently I would not cognize the number. (Guyer/Wood, trans.)

The activity of, say, counting means something only by virtue of the representation of one's activity as part of an ongoing process, where what part of the process is past matters to the meaning of the current phase. And counting, for Kant, is here just standing in for any generation of coherent experience out of an intrinsically inchoate succession of thoughts and experiences.

Second, as we also discussed in chapter 2, Kant makes the case that experiences do not come temporally presorted, and that the basic guidelines for doing the sorting are innate; further, he argues that the key function of these innate guidelines is to allow us to make temporal sense of our own experiences by relating them to things and events outside ourselves. Doing this requires that we have an instinctive grasp of the difference between future, present, and past, for the reason that—and this is the key point—we could never get started with sorting out our experience unless we presume that we are *restricted* both spatially and temporally with regard to what we can be perceiving at any moment. In recollection, I remember both one event A and another B. Did the experience of B come before A, or after? Why pick one or the other? The answer is that we automatically organize our experiences as being restricted to the here and now, with future and/or distant events inaccessible until we are in a position, in terms of our own spatial and temporal location, to have the experience in question. Without the presumption of spatial and temporal restrictions on what we can perceive, there would be nothing constraining how we might organize a given set of perceptions at any moment. As Kenyan philosopher Quassim Cassam puts it:

> To get a grip on the idea of perception of what can also exist unperceived, one must think of perception as having certain spatiotemporal enabling conditions, such that in order to perceive

> something one must be appropriately located—both spatially and temporally—with respect to it . . . [This assumption] enables one to account for the fact that a perceivable object is not actually perceived by appealing to the possibility that the spatiotemporal enabling conditions of perception are not met with respect to it.

Putting these points together, it looks like a world-concept that includes progressive spatiotemporal situations explaining the difference between perceived and unperceived is necessary for coherent experience. This is not the same thing as representing oneself as being timelessly located in one place at one moment and in another place at another moment; in other words, a temporally static picture of reality is insufficient as a precognitive organizational principle. Rather, our schema for interpreting our experience involves essential reference to the experiencing subject's dynamically changing location in time (and space) that accounts for the *gradual unveiling* of hitherto inaccessible objects or events, and thus suggests the spontaneous representation of change specifically in dynamic theory terms.[4]

It's a short step from these essential aspects of cognition to the idea of a flow of time. As Barry Dainton puts it,

> Even if our future experiences are just as real as our past ones . . . at any given point during our lives we have detailed knowledge only of the earlier parts of our life; indeed, for all we know we might be about to drop dead, and so not have a future at all. It is thus easy to believe that our lives don't extend beyond the

4. This claim only concerns self-conscious, experience-synthesizing beings such as *Homo sapiens*. There is a lot of work to do on how other animals process temporal information. Maybe some are a lot like us in this respect; others are presumably working off instinctive responses, rather than cognition and consciousness.

> present, even if in fact they do. This belief leads to another: that any continuation of our lives involves the addition of something new to the already completed past. Since we remember having these same beliefs at past stages of our lives, and anticipate having them in the future, we always have the impression of living at the outermost limit of an ongoing future-directed process.

The notion of an essential spatiotemporal point of view is tied up with the idea that we are enduring subjects of perception, traveling a path through space and time and actively building memories—and a representation of the world—as we go. This 'self' of ours is a projection too. As David Hume famously observed, there is no more an enduring-self phenomenology than there is a changing-now phenomenology:

> For from what impression could this idea be derived? This question it is impossible to answer without a manifest contradiction and absurdity; and yet it is a question, which must necessarily be answered, if we would have the idea of self pass for clear and intelligible, It must be some one impression, that gives rise to every real idea. But self or person is not any one impression, but that to which our several impressions and ideas are supposed to have a reference. If any impression gives rise to the idea of self, that impression must continue invariably the same, through the whole course of our lives; since self is supposed to exist after that manner. But there is no impression constant and invariable. Pain and pleasure, grief and joy, passions and sensations succeed each other, and never all exist at the same time. It cannot, therefore, be from any of these impressions, or from any other, that the idea of self is derived; and consequently there is no such idea.

An illusion is a perceptual experience that is misleading in some way. There is no experience of a self, so the self can't be an illusion. Self-representation as a persistent, identical subject of experience is, once again, the effect of projection rather than illusion—of misconception rather than misinformation. We believe that we endure as identical selves over time, and this profoundly affects our representation of the world. We think that we *perceive* events as passing us by only because we *believe* ourselves to be enduring, embodied agents traveling through time. As French phenomenologist Maurice Merleau-Ponty put it,

> Time presupposes a view of time. It is, therefore, not like a river, not a flowing substance. The fact that the metaphor based on this comparison has persisted from the time of Heraclitus to our own day is explained by our surreptitiously putting into the river a witness of its course. (Smith, trans.)

We do this automatically and unconsciously as part of the essence of cognitive processing itself; this is why we so easily confuse our way of processing the world with our way of perceiving the world as it is. In the words of theoretical physicist David Bohm, "Thought creates the world and then says, 'I didn't do it.'"

We get started putting our thoughts and experiences together coherently by sorting them out in time. Kant's claim—that experience is only possible by virtue of its temporal organization in terms of rules involving a world of objects and events—ultimately also implies that one must innately presuppose that one's experience derives from dynamic changes in one's environment and spatio-temporal position; in short, one *must* begin by thinking in terms of having present experiences (and progressively accrued memories) with further, potential experiences 'on the way'.

The idea that the passage of time is unreal in itself yet, apparently, conceptually indispensable places us in an odd position. On the one hand, logic and science seem to leave no room for dynamic change; on the other, the indispensability of the ideas of past, present, and future would mean that we literally cannot contemplate a world without the flow of time. One might well argue that you can't have it both ways: How can you say that change isn't real, but a changeless world cannot be contemplated? If you say change isn't real, are you not thereby contemplating a changeless world? This sort of consideration motivates Kant's more synoptic idealist program in the *Critique of Pure Reason*, wherein we can preserve natural science only by conceding that it functions exclusively as a description of the world-as-we-know-it rather than the world as it is in itself.

With or without a full-blown idealism, we can agree that the passage of time is an indispensable part of our basic conceptual scheme, a necessary presupposition that makes coherent experience possible. As with the case of moral judgment, our attribution of dynamic change to events in the world is a matter of projection—though in this very special case, this way of representing the world is necessary to our having any coherent representation of the world at all.

There is no illusory phenomenology *as of* the passage of time. Our belief that we perceive the passage of time is the result of the way we conceive of ourselves and our experiences. Any formal or informal commitment we have to the reality of the passage of time is based not on *misinformation* but *misconception*: We misdescribe our own experiences not in terms of what the content of our experience shows, but rather in terms of the type of experience it is in the first place.

The point of the above discussion of Kant is that this misconception is neither optional nor corrigible. Whatever the world is really

like, on a basic operating level we can't do without thinking of it in terms of dynamic change . . . which doesn't really come as a surprise to anyone who has tried (and failed) to imagine the world without it! Projection is all about conceptual confusion. No wonder we get confused as to the reality of the passage of time.

All events being equally real (as the static theory insists) doesn't mean that all events deserve the same cognitive or emotional response at every moment we think about them. The adaptive advantages of this manner of representing the world help explain why it is a feature of our species' cognitive and affective systems. Thinking of the world as divided into past, present, and future can be useful even if the world neither is dynamic nor even appears dynamic. It is essential to our prospects of survival that we respond differentially to events according to their causal relation to us at any given time. For any sort of being who acts on the basis of beliefs rather than exclusively on instinct, taking the right actions at the right times is often dependent on having beliefs like "*Now* is the time to eat/sleep/resist/run away." Our ancestors derived tremendous advantage from their capacity to plan ahead and to engage in collaborative activities over periods of time. Other species do a lot of things really well, but the complex collaborative activities that demand explicit time consciousness also define the evolutionary niche humans have enjoyed.

Intentional action requires motivation as well as cognition; situationally appropriate emotional attitudes serve as the motivators for acting on time-indexed beliefs. Future-directed emotions like desire, anticipation, and apprehension are essential to the execution of individual and collaborative projects aimed at some later goal; past-directed emotions motivate changes to our strategies based on what we have experienced. All this would suggest that 'tensed' emotions are evolutionary adaptations, just as 'tensed' cognition

is. In an effort to understand temporally asymmetric attitudes like apprehension and relief in the context of the static theory of time, New Zealander philosophers Heather Dyke and James Maclaurin have examined time consciousness through the lens of evolutionary biology. As they explain, feelings of, say, relief exist as human emotional states because "at the time at which a fearful experience is past, from our temporal perspective, we *then* no longer have to expend great amounts of adrenaline trying to avoid it. It is this contrast which we interpret as relief." All that is really going on is that, at 2:15 p.m., I am apprehensive about my imminent tooth extraction at 2:30 p.m. I am distressed about the pain as my tooth is extracted; and at 2:45 p.m. I am relieved that the experience is over. That's it. This account includes a sequence of appropriate, time-dependent emotional states, without one of these times actually having an objective status as *present* and the others *past* or *future*. The meaninglessness of an absolute now is perfectly consistent with my having different beliefs and attitudes, at any moment, regarding what is 'currently' happening and as to what lies in the past or future. In fact, I need such beliefs and attitudes to function efficiently as the kind of agent I am. Recognizing the centrality of these beliefs and attitudes is not the same as saying the corresponding representation of the world constitutes an accurate reflection of reality. What time it is now matters enormously, but only *to me*, and only to me *now*. From the universe's perspective (that is to say, from no perspective), it doesn't matter at all. Arthur Prior was right to point out that we cannot simply translate "Thank goodness that's over" (as uttered on Friday, June 15, 1954) into "Thank goodness the date of the conclusion of that thing is Friday, June 15, 1954". These do mean different things, but the first locution says something about change only insofar as we are bound to conceptualize it.

It is inevitable that we shall continue to speak in terms of the passage of time. While we can at least conceive of dispensing with, say, color terms in thought and communication, the same can't be said for A-series concepts and temporally asymmetric emotions. We cannot rid ourselves of dynamic time talk; nor should we feel that we must try to do so outside of a formal scientific or philosophical context. Our answer to the issue of reconciling manifest time with scientific time must be to accept that there will never be some sort of ultimate unification of experience and reality. Logic and science will tell us one thing about reality, even as our thoughts and emotions continue to insist otherwise.

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Chapter 6

The Direction of Time

If the dynamic theory of time is wrong, then the future isn't coming, the present isn't happening, and the past isn't receding. Nevertheless, the static theory agrees with the dynamic theory in treating time as a real dimension with a fixed direction: Some events are really earlier than others, some concurrent, and some later. But in a static block universe, what does it mean to say that time has a direction? Does the direction of time emerge from something more fundamental? Could the direction of time, like the passage of time, be just another product of psychological projection?

TIME'S ARROW

The rejection of A-series temporal properties (pastness, presence, and futurity) raises a deep question about B-series temporal relations (earlier than, simultaneous/concurrent with, and later than). The static theory of time embraces the block representation of the universe, according to which all times and all events are equally real. The rejection of the dynamic theory means that time does not flow, or pass; nevertheless, static theorists regard time as a real dimension,

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 DOI: 10.1093/oso/

with events really ordered from earlier to later. The very nature or meaning of the relations "earlier than" and "later than" includes the notion of a temporal asymmetry: Looking back to earlier events is just inherently different from looking forward to later events. This asymmetry is easy to explain if we believe in a real past, present, and future: Event A is earlier than event B if it lies in B's past. Time's one-way direction would follow from the dynamic becoming of events. Yet we have seen that there are decisive reasons to reject the notion of intrinsic temporal properties like pastness, presence, and futurity. So why would a static block of events have a *direction*? What explains this one-way ordering of events from earlier to later, if it does not rest on the difference between past and future? This problem led McTaggart to question not only the reality of the passage of time, but also the reality of time itself as a dimension. McTaggart suspected all along that, just like the notion of a moving present, the notion of an objective earlier-later direction of time is based on a confusion. As we discussed in chapter 4, he ultimately proposed that events are ordered only as a "C-series": an array of events that are not only static but also lack a temporal dimension. The English alphabet is an example of a C-series: It so happens that we are used to reciting it from A to Z, but the list of letters itself has no inherent direction from A to Z. The alphabet recited from Z to A is the same alphabet in every way. This is not how we tend to think of the universe and its events. A universe in which every event happens in reverse order sounds like a different universe from ours—a temporally reversed universe. But if we reject the misconception that things 'happen' and that the universe 'runs' one way or the other, then our intuitions about forward and backward don't seem to have any application. We have seen that our belief in the passage of time is explained by psychological projection. Is the one-way direction of time, as represented by the earlier-later relation, also merely a matter

of projection, or does the apparent directionality of time really correspond to something in nature?

The directionality of time is often referred to as **the arrow of time**. When we refer to time's arrow, we really have several closely related temporal asymmetries in mind. Two of them are perhaps the most salient in our ordinary way of speaking about time's direction. The first (the **psychological arrow**) pertains to the way we think and feel differently about future events than we do about past events. The second (the **causal arrow**) is the way in which we think past and present events cause future events but not the other way around. According to a predominant account, situated at the intersection of physics, philosophy, and psychology, these asymmetries are each explained by the physical and informational phenomenon known as **entropy**. What entropy might have to do with the alleged arrow of time is the main subject of this chapter.

THE PSYCHOLOGICAL ARROW

The psychological arrow keys on the familiar fact that we remember (and never anticipate) the past, and anticipate (but never remember) the future. This fact explains how we come to have those temporally asymmetrical emotions discussed earlier, like sorrowful regret and eager expectation; we 'look forward to' what we anticipate and we 'look back on' what we remember. The psychological arrow includes a closely related epistemic dimension. We know things about the past in very different ways than the ways in which we can predict things about the future. These emotional and epistemic asymmetries are in turn deeply entangled with our self-concept as agents: We think of ourselves as beings who have some control over our future but cannot change our past. Together, these

emotional, epistemic, and agential asymmetries govern virtually all our thoughts and feelings regarding our lives and the world around us. It seems impossible even to contemplate life without the arrow of time.

There seems to be a perfect correlation between the psychological orientation of our lives and the alleged direction of time. Yet, for anyone who thinks there is anything mind-independent about time, the direction of time could not itself be *explained* by this psychological asymmetry. This would make the difference between earlier and later an entirely subjective phenomenon, and consciousness the fount of every aspect of time. Surely we would not allow the difference between earlier and later to depend on what falls into the contents of each individual's memory. Our first option must be that it is the order of events that explains the psychological order, not the other way around. If we want to maintain that the arrow of time is real, then we need to look elsewhere to explain it.

THE CAUSAL ANALYSIS

So let's look at the causal arrow, which, like time, seems asymmetric: According to the ordinary notion of cause, causes temporally precede their effects. Typically, then, we think of the causal arrow as necessarily pointing the same way as the temporal arrow—so one might well suppose that the latter is a function of the former. Indeed, G. W. Leibniz proposed that time's arrow is to be understood in terms of causal explanation. Like his fellow temporal relationist Aristotle, Leibniz held that time is not something real in itself but rather is our way of representing certain kinds of relations between events. Here he explains how thinking in terms of time order is

just our way of understanding the relation of causal or explanatory dependency:

- *If many states of things are assumed to exist, none of which involves its opposite, they are said to exist simultaneously*. Thus we deny that the events of last year are simultaneous with those of this year, for they involve opposite states of the same thing.
- *If one of two states that are not simultaneous involves the reason for the other, the former is held to be earlier, the latter to be later*. My earlier state involves the reason for the existence of my later state.[1] And since, because of the connection of all things, my earlier state involves the earlier state of the other things as well, it also involves the reason for the later state of those other things, so that my earlier state is in fact earlier than their later state too. And therefore *whatever exists is either simultaneous with, earlier than, or later than some other given existent*.
- *Time is the order of existence of those things that are not simultaneous*. Thus it is the universal order of changes, when the specific kind of change is not taken into account. (Loemker, trans.)

According to Leibniz's version of temporal relationism, the direction of time is explained by the *direction of explanation*. What is real is the causal relation; the concept of the earlier-later relation is just our way of understanding or representing the causal direction. So, for Leibniz,

1. Leibniz's notions about causation are tied up with his theological views about God's complete control over the universe and God's intention to create the ideally perfect series of events. For Leibniz, physical laws describe natural regularities rather than explain them; the fundamental explanation for the impact of one event upon another has to do with God's reasoning. Thus Leibniz prefers the language of an event as the "reason" for another rather than a "cause" of another. But he finds causal language perfectly appropriate in the context of scientific explanation.

an event A is earlier than some other event B simply in that the occurrence of A either helps explain B or coexists with some occurrence that explains B. This definition would account for an inherent temporal direction by identifying an objective basis for the difference between earlier and later. Further, the fact that causes always precede their effects would easily explain the psychological asymmetry: On this account, memories pertain to the past just because they are causally explained by the events of which they are memories.

The causal analysis of temporal asymmetry looks attractive in several respects. Unfortunately, it appears to presuppose the very concept that it aims to explain. The problem is that of coming up with a definition of causation that does not itself rely on the concept of temporal asymmetry. It would seem natural to define a cause as *an event that brings about another event*, or, alternatively, as *an event that precedes another event according to natural laws*. But each of these employs the notion of temporal precedence in defining the concept we are trying to use to analyze temporal precedence. We can't resolve this circularity by defining a cause as *an event necessitating a later event* or as *an event increasing the probability of a later event*. Either way, temporal sequence would remain an essential part of the analysis of the concept of causation. As we shall see shortly in discussing entropy, no sequence of events is truly irreversible according to the laws of nature. Thus any event could be followed in time by the event we would normally refer to as its "cause". Regardless of how we define "cause", the fact that A "causes" B doesn't by itself give us a direction: We would need to include the fact that A *precedes* B, which assumes the temporal asymmetry that the causal analysis seeks to explain.[2]

2. There are other ways people have tried to define 'cause' without referencing time, but these definitions all seem to have insuperable difficulties. I refer the reader to Jonathan Schaffer's article on the metaphysics of causation in the online *Stanford Encyclopedia of Philosophy* for an overview of the different candidate analyses of causation.

One fallback account of causation views the causal relation as a primitive, unanalyzable notion. **Primitive concepts** are concepts that are so fundamental to thought and reality that they cannot be defined in any terms other than themselves. (Other concepts that have been thought candidates for primitiveness include "existence" and "truth".) This could be thought to dissolve the above problem. The problem with the causal analysis of temporal direction is that any attempt to analyze causation seems to involve time; if causation is primitive, the problem is solved by fiat, as it were, because there simply is no analysis of causation.

The problem with holding causation to be primitive is that this would seem to make knowledge of causal relations impossible. As David Hume famously pointed out, we do not experience causal relations over and above experiencing the related events themselves: All we ever actually experience are repeated sequences of similar types of events. It is the experience of these sequences of events that leads us to associate these event-types with each other—and thus to the idea that the events are causally related. But if causation is primitive, then it is not to be understood in terms of patterns of events. So no knowledge of how some type of event tends to follow another type could constitute knowledge of causal relations. Consequently, such knowledge would appear to be impossible on the theory that causation, as a primitive concept, is not to be analyzed in terms of anything else.[3] For reasons like these, the causal arrow does not look like it could qualify as the ultimate explanation for the temporal arrow.

3. Further, the idea that the direction of time is fixed by the causal arrow would be undermined by the possibility of traveling to an earlier time. As we shall see in the next chapter, time travel is neither logically nor physically out of the question. The possibility of time travel to the past would tend to further undermine the identification of the temporal and causal arrow, because later events could then cause earlier ones.

THE ENTROPIC ARROW

The second law of thermodynamics describes the tendency of energy in a closed system (i.e., a system that is not getting energy from the outside) to 'spread out' until the system reaches a state of equilibrium. This rule is the origin of the broader physical concept of **entropy**. In brief summary, entropy can be understood as the relationship between the macrostate of a system (say, the temperature of a room in a house) and its microstate (in this case, the activity of the molecules making up the air in the room). The macrostate of a system tends to balance out as elements of the microstate interact with each other and transfer energy. A state of things where the energy is unevenly distributed is a "low entropy" state. A state of things at a higher level of equilibrium is in a higher entropy state. Without intervention from the outside, systems with an overall energy imbalance always tend to move toward a state of greater equilibrium. If one side of the room has a higher temperature than the other, this energy will tend to balance out (barring further input from, say, an electric heater) as the more energetic molecules bounce around randomly until the heat energy in the room is more or less equally distributed. The latter distribution of energy represents a higher entropy state than the former.

(Note that "temperature", as in room temperature, is not a fundamental property in itself, but rather an **emergent property**: What we call the temperature of the room is really just a matter of the combination of the individual properties of the air molecules. The notion of an emergent property is important for our purposes because it is sometimes suggested that the temporal arrow "emerges" from the entropic arrow in this sense.)

At first glance, the entropic arrow might appear to be the right kind of thing to account for time's direction. Twentieth-century astrophysicist Arthur Eddington explicitly identified the temporal arrow with this entropic arrow: Time has a direction because of the laws of thermodynamics. These laws dictate that overall energy at later times is always more diffused than at earlier times. We make judgments about what has happened, given the current situation, based on the assumption that systems increase in entropy over time. The presence of chocolate pudding is reasonably thought to indicate the past existence of separate quantities of milk, sugar, cocoa, and gelatin, but it doesn't work the other way: Seeing some quantities of milk, sugar, cocoa, and gelatin does not lead us to infer the prior existence of some pudding from which their separate existences were derived. Making pudding is a one-way affair, and the kind of unidirectionality we are talking about here seems to coincide nicely with the direction of time. Eddington thought of this directionality as fundamental:

> The law that entropy always increases holds, I think, the supreme position among the laws of Nature. . . . [I]f your theory is found to be against the Second Law of Thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation.

The questions we need answered, then, have to do with the alleged relationship between entropic asymmetry and temporal asymmetry, and what that relationship would say about whether the temporal arrow is a mind-independent aspect of reality.

Do systems *have* to follow the laws of thermodynamics in terms of energy distribution, and, if so, why? Nineteenth-century Austrian physicist Ludwig Boltzmann was responsible for the

biggest breakthrough in our understanding of thermodynamics. He proposed that thermal kinetic energy in general boils down to the random motion of atoms—and thus that entropy is just a matter of statistical probability. Systems move from lower to higher entropy simply because higher overall entropy states are more probable. The tendency toward higher entropy is reflected in the behavior of just about any system one can think of. Once out of the oven, hot pizza always cools rather than warms; omelets do not become whole eggs; smoke, ash, and heat from a fire never reassemble themselves into wood. Why is this? Simply because there are very many more ways for energy in a system to be dispersed rather than concentrated. There are many more ways for a drop of ink to be diffused throughout a container of water than for it to be concentrated in one area. *Every* particular distribution of the ink molecules in the water—including ones where the ink is diffused evenly—is equally wildly unlikely to the point of being almost impossible; it is just that most of those equally unlikely distributions involve the ink being diffused rather than concentrated. There are many more possible versions of a broken egg than a whole one; there are many more ways for water to spread out as a liquid than to be condensed as an ice cube. Simple chance thus dictates that, over time, any imbalanced macrostate (that we do not spend energy to maintain) will tend to even out into a much, much more likely equilibrious arrangement. What this all means is that entropy is not the *cause* of what we see happen over time, but rather the *effect* of innumerable interactions taking place in accordance with statistical probabilities.

In fact, as far as we can tell, the laws of physics have no preferred direction of time. If you took a video of any physical process at any level and viewed it in reverse, what you would see would not

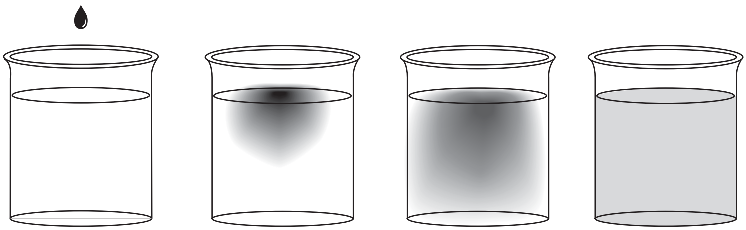

Figure 6.1. Ink diffusing in water. This process could randomly and spontaneously occur in reverse without violating any natural laws.

violate any physical laws.[4] From this we can conclude that the entropic arrow—the arrow that looks like the best explanation for the apparent temporal arrow—does not derive from any fundamental physical laws. (See figure 6.1.)

Mere statistical probability can explain why the universe will always tend toward higher entropy arrangements. Other things being equal, however, that tendency should work both ways—both to the future and to the past: Whatever level of entropy we are dealing with at any moment, probability dictates that higher overall entropy should lie in both directions—future *and* past. But that's not what we see. What we call the past is always lower entropy, and the future higher. The laws of physics have no preferred direction, yet the universe seems to. That's why Boltzmann added another proposition to his statistical account of thermodynamics. He added a hypothesis now known as the **past hypothesis**: the proposition that our universe somehow began in a highly unlikely, very low entropy state. Given a very low entropy state, things can only develop, statistically speaking, in one way—toward higher entropy.

4. Some interpretations of quantum mechanics would insert a kind of inherent asymmetry into some sequences of events, but that hypothetical asymmetry would not have any clear relevance to the temporal arrow.

Indeed, looking back at the early universe we can see that the early universe was in a hot, condensed, macroscopically homogenous state—a universe-wide low-entropy state.[5] Just why the universe would ever find itself in this bizarrely unlikely state is one of the primary questions in physical cosmology. If high entropy macrostates are always more likely than low-entropy ones, then wouldn't it be implausibly unlikely that the universe should have ever found itself in such a simple state? The answer to this demands a cosmological theory as to the origin of the universe (an issue we shall return to in chapter 9). This weighty question aside for now, this low-entropy state gives us a universe with a clear, overall thermodynamic and entropic arrow.

The coincidence of the entropic direction and the alleged direction of time is striking. Yet the so-called 'law' of thermodynamics describing the entropic arrow is merely statistical. If the direction of time is a fundamental and mind-independent aspect of reality, the direction of time can't just be a matter of probability. As we noted, there is no force or underlying rule that prevents every molecule of ink diffused in water from collecting in one spot; it is just that it is preposterously unlikely that every molecule of ink will happen to be randomly heading in that direction at the same time. Even if something so unlikely should happen, we would not want to say that the liquid was moving backward in time. It would just be a case of a normal process producing a surprising result, like the ball on a roulette wheel landing on a specific number 50 times in a row. The chance of that happening is so small that you would probably not get that result even if you spent trillions of years trying. But it is not

5. The fancy way of saying this is that the universe has a low-entropy **boundary condition**. The point is to avoid calling this the "early universe" in formal contexts. This way we do not presuppose an arrow of time from earlier to later in the description of this state of the universe.

impossible. As unlikely as it would be, such a sequence of events could occur without violating any laws of nature.

Now suppose that, by wild happenstance, *all* processes similarly trended in a low-entropy-simulating manner, such that the whole universe, over time, became a less equilibrious place.[6] Would this constitute a reversal of time itself? Only if we give up on the idea of a fundamental direction of time. If time is reversed if the whole universe spontaneously became less equilibrious, then it should be as well for any little subsystem that becomes less equilibrious. Identifying time with the entropic arrow would make the direction of time a contingent, local, and potentially temporary phenomenon.

Consider once again the diffusion of the drop of ink. We have talked about how it is unlikely yet technically possible for such a process to reverse itself and turn into a process of concentration, wherein the ink molecules happen to gather themselves together and launch themselves out of the container. Note how the very description of thermodynamic probabilities presumes a direction to time. The ink, we say, "diffuses". If you look at the same process backward, you would be looking at a process of "concentration". But why call that the "backward" direction? What entitles us to speak in terms of the movement toward diffusion as the "forward" direction and the movement toward concentration as the "backward" direction? The statistical tendency *toward* (as opposed to *away from*) equilibrium is only the norm if we have already decided that time has a direction and that processes tend to become more disorganized in that direction. As Susan Stebbing wrote in criticism of Eddington,

6. Notice that I said "became" a less equilibrious place, the phrasing of which presumes a direction of time. This is a consequence of lacking a convenient language that doesn't include dynamic temporal concepts as part of its very structure.

> Eddington seems temporarily to have forgotten that the second law of thermodynamics is not an a priori principle but a well-established *experimental* law, 'very deeply rooted in physics'. He has forgotten that in order to discover the law scientists had to perform experiments. . . . But if increase in entropy is the criterion of the distinction of earlier from later, how was it discovered that entropy increases *as time goes on*? The experimental physicist had to remember the order in which he took the readings of his thermometers; that is, he had to know which record was the earlier, which the later, before he could have detected that entropy increases in an irreversible direction.

Even calling a process like the diffusion of the ink "diffusion" betrays the fact we have already assumed an inherent direction for the process. We call it "diffusion" because we remember the ink being more concentrated and anticipate it being less concentrated. That is just the psychological arrow again. Any specifically *temporal* description of the entropic arrow is imposed by us on the world.

WHY DO WE REMEMBER THE PAST AND NOT THE FUTURE?

Regardless of the reality of time itself, our own psychology is the immediate reason why we assign a direction to time. Memory has a direction. We remember events in one direction and merely anticipate events in the other. There is a closely related epistemic arrow: the type of knowledge we have about the past is different from any type of prediction we may make about the future. Why do we relate to the world in this way? If we live in a block universe, then why can't we remember the future just as well as the past? One possible

answer lies in how memory formation as a physical process is tied up with entropy. Note that an increase in entropy is an increase in the involvement of parts of a system with each other—for example, via the exchange of energy from one part of the system to another, as in the case of the trend toward room temperature equalization. These random interactions between the parts of the system leave potentially reconstructible traces—a kind of history, you might say. Tracking correlations that stack in an understandable manner is just what it is to be making sense of experience over time. In forming a memory, we reconfigure relationships between our neurons in response to interactions with the outside world. This creates a local increase in interconnectivity within parts of our brain responsible for memory (at the expense of a slight expenditure of energy, a dissipation of bodily heat, and thus an overall entropy increase). On this description, the formation of memories sounds like it is itself part of the thermodynamic/entropic trend. The one-way entropic trend explains the one-way increase in correlations between our brain states and the outside universe. (Remember that we ourselves are just physical systems interacting with other physical systems within one larger physical system!)

So the story runs something like this: At the far end of the known universe we call the "early" universe, things were in an overall, macroscopic low-entropy state; this overall low-entropy state at one end explains why we see this directionality in correlations that form between parts of physical systems, as interactions happen and matter and energy tend toward interrelation. Memory involves interrelations between brain states and the environment; so memory points one way. Further, because there is one overall direction of *mutual involvement,* the retracing of understandable causal explanations for current events is dictated by the entropic trend. Thus, when we try to explain events, our explanatory strategies only

point one way because earlier events tend to come together in predictable ways (whereas later events can be very effectively *traced* to earlier events but can't sensibly be used to *predict* earlier events). Every event could be explained by, or used to explain, both 'past' and 'future' states of things. Our decisions as to when to identify certain events as causes of others follow our explanatory and predictive abilities.[7] As physicist Carlo Rovelli has argued, from our standpoint as agents, our interest in past and future events is asymmetric because our interactions with the world—thanks to the contingent entropic arrow—are only effective in one direction. This is where we get the idea of ourselves as having some control over events—but only over what we call "future" events. Our sense of agency only goes one way because, for us, memory, prediction, causation, and explanation are asymmetric. In turn, our emotional attitudes follow the directions dictated by what agency means to us. But all of this is dependent on the mere probabilities underlying the entropic arrow. Fundamentally, the universe does not have an inherent temporal direction; every event in a chain of events is part of a larger story that is, in itself, atemporal. This is McTaggart's C-series (or Augustine's eternity): a real universe of real events that exist in a determinate order, but without even the temporality that the passage-denying, static B-theorist accepts.

Suppose we lived in a condensing universe in which entropy was decreasing. In that universe—according to the theory linking the entropic and psychological arrows—we would remember the 'future' and anticipate the 'past'. But the past, in that universe, would be

7. Philosophers Peter Menzies and Huw Price have gone so far as to offer what they call the "agency theory" of causation, according to which an event qualifies as the cause of another just in case bringing about the former type of event would be a way for a conscious agent to bring about an instance of the latter.

just like the future in ours, and our future would be just like its past. What difference would that make? (See figure 6.2.)

The notion of an inherent temporal direction doesn't really seem to be adding anything to the story of how and why things appear the way they do to us. There is no more reason to call the psychological past and future, respectively, the "backward" or "forward" direction than there is in the case of the entropic arrow. As it is with what time it is *now*, the *direction* of time means something to us, but it means nothing to the universe.

Like other temporal idealists, McTaggart thought that reality is inherently atemporal. The above considerations about time's arrow support the claim that a direction of time may arise from our way of cognizing reality rather than from the intrinsic nature of events and their relations. The precise connection between the psychological arrow, the entropic arrow, the causal arrow, the explanatory arrow, et cetera, is a very complex issue. There is a good bit of agreement on the big picture as summarized here, but a fully executed account, as usual, awaits developments in physics, cosmology, and psychology.

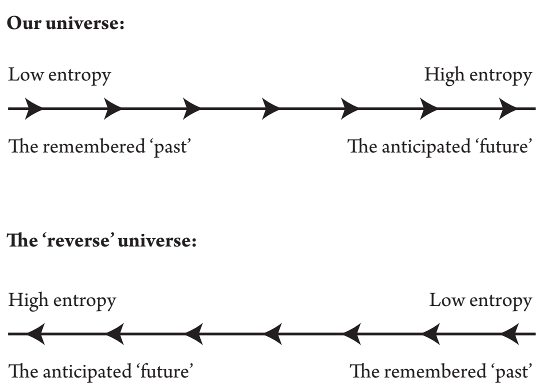

Figure 6.2. What is the difference between these two scenarios?

QUANTUM ENTANGLEMENT AND THE DIRECTION OF CAUSATION

As an example of what quantum physics might have in store on this issue, consider Australian philosopher Huw Price's interpretation of the behavior of certain microphysical processes. Price's account explicitly supports the idea that the direction of time, like the passage of time, is a matter of psychological projection. In the quantum realm, or the realm of the very, very small, scientists have observed phenomena that call our presumptions about the nature of physical law into question. For example, under certain conditions, the setting on an instrument used to measure the behavior of one photon spatially separated from another appears to determine the state the other is in. This relationship of seeming mutual dependence is called **entanglement**. The kinds of correlation we see with entangled particles would seem impossible unless particles are able to instantaneously communicate with each other at a distance. Such **nonlocality** or, in Albert Einstein's dismissive words, "spooky action at a distance", would seem to conflict fundamentally with relativistic physics. Yet entanglement is undoubtedly a real phenomenon; the question is how to interpret it. Some interpretations include allowing nonlocality and thereby rejecting classical physics altogether.

Along with allies such as physicist Ken Wharton, Price is puzzled by the nonclassical, nonlocality interpretation of quantum correlations. He thinks that this doesn't take the static theory's block universe perspective seriously. If you take the block universe proposal seriously (as physicists generally do), then why presume that causation only works in the so-called forward direction? If we truly live in the timeless reality described by physics, then why can't

the future affect the past just as the past affects the future? What Price proposes is that what we are seeing in the photon experiments is **retrocausation**: On his view, the *later* measurements are causally influencing the *earlier* properties of the particles. That influence would explain their observed correlation without instantaneous nonlocal influence, and thus without our having to abandon classical and relativistic physics.

The same goes for familiar claims in quantum mechanics as to the **indeterminacy** of the states of elemental particles before they are measured. Experiments like the one suggesting nonlocality are sometimes taken to imply that subatomic particles literally remain in indeterminate states until observed. Such claims culminated in the famous "Schrödinger's Cat" thought experiment. Austrian physicist Erwin Schrödinger thought this indeterminacy was absurd. He explained how one could put a cat into a sealed box with some poison such that the release of the poison is dependent on the state of a subatomic particle. If the indeterminacy interpretation of these quantum phenomena is correct, we would have to conclude that the cat is both alive and dead until the box is opened; and only at the moment the box is opened does the cat enter into a determinate state of being alive or being dead. His point was that there had to be something wrong with any interpretation that leads to this ridiculous conclusion.

The proposal that causation can work both ways, so to speak, has the advantage of allowing us to dispense with the "conceptual horrors" (as Price calls them) of nonlocality and indeterminacy. No more spooky action at a distance and no more cats that are both alive and dead.

Why does the notion of retrocausation seem so strange? Only, Price asserts, because we are so used to seeing the thermodynamic arrow point in one direction when it comes to the macrophysical

world of our ordinary experience. Had we approached the quantum state experiments from the standpoint of a timeless universe in the first place, he argues, we would have seen these correlations as straightforward evidence of retrocausation. It is a deep but inherently unsupported prejudice against the so-called 'later' explaining the so-called 'earlier' that gets in the way of an otherwise simple explanation of these quantum correlations.

Price supports the idea of an inherently time-symmetric universe. Our representation of the arrow of time is a product of our preconceived notions about how causation works. The causal arrow, he argues, is a mere human projection related to the statistical thermodynamic asymmetry of the macrophysical world. He explicitly compares the notion of one-way causal relationships to sensory properties like visual color: The ascription of causal powers to events is the result of psychological projection, just like the ascription of color to objects. The feature of our experience that results in our ascribing color to objects, of course, is just the visual sensation itself. Price asks,

> What feature of our perspective could it be that manifests itself in the cause-effect distinction? The most plausible answer is that we acquire the notion of causation in virtue of our experience as agents. Roughly, to think of A as a cause for B is to think of A as a potential means for achieving or bringing about B. . . . The origins of causal asymmetry thus lie in our experience of doing one thing to achieve another—in the fact that in the circumstances in which this is possible, we cannot reverse the order of things, bringing about the second state of affairs in order to achieve the first. This gives us the causal arrow, the distinction between cause and effect. The alignment of this arrow with the temporal arrow then follows from the fact that it is normally impossible to achieve an *earlier* end by bringing about a *later* means.

If the retrocausal view is correct, we can bring about a change to the earlier state of subatomic particles by measuring their state at a later time. But this sort of causation isn't relevant to our sense of agency because we didn't evolve with this sort of causation as a part of our experience.

Like Rovelli, Price concludes that the true "view from nowhen"—a perspective treating the space-time continuum like the timeless block it is—would include neither an inherent time direction nor an objective, uniquely one-way causal arrow. The macro-level entropic arrow determines the direction in which thought, explanation, and agency work. That's how we get the psychological arrow—and our experience of the arrow of time is just a projection of our subjective psychological arrow.

The retrocausal account of apparent quantum nonlocality and indeterminacy remains an interpretation, and a highly controversial one at that; again, however, it has the big advantages of (a) elegantly allowing us to dispense with the counterintuitive notions of nonlocality and indeterminacy, while (b) accounting for our alleged experience of the arrow of time despite the fact that the universe has no use for it. In light of everything we have seen pertaining to the physics and philosophy of time, it may be worth considering.

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Chapter 7

Is Time Travel Possible?

The static theory of time treats temporal location much like spatial location: Each temporal slice of the spacetime continuum is just as real as any other, just as any part of space is just as real as any other. Some might suggest that this means that travel to other parts of time should be possible, at least in theory, just as travel to other areas of space is possible. Thus an investigation of the implications of the static theory of time is at the same time an investigation of the possibility of time travel.

FICTIONAL (AND NON-FICTIONAL) TIME TRAVEL

Many novels and movies from the last century and more feature fantastical depictions of time travel. From the 1895 H. G. Wells book *The Time Machine* to popular films like 1985's *Back to the Future*, many exciting tales have been spun involving a leap of some sort from a present time to a past or future time. The time traveler in *The Time Machine* builds a machine (the operating principles of which are unclear) that takes him both to his own past and to a far future state of the earth. The protagonist of *Back to the Future* travels (once

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again, technical details are fuzzy) to a past state of his hometown, where he performs actions that result in alterations to conditions in the era from which he came.

As much as entertainments like these capture the imagination of readers and moviegoers, they typically are not the product of a serious consideration of either the logic or physics of time. What sort of travel do these storytellers have in mind? Colloquially, what we usually mean by "travel" is travel *through* space (say, from New York City to Paris) *over* time. Although it does take time to get there, the destination is defined by its spatial, not its temporal, location. Further, when we travel somewhere we suppose that our destination exists—that there is somewhere to go. Time travel is travel to a time that exists, just as more familiar forms of travel involve traveling to a place that exists; in the way, the very notion of time travel treats temporal locations like spatial ones. While this metaphor might work under the suspension of disbelief we allow ourselves in enjoying a work of fiction, it doesn't just go without saying that time travel is a coherent notion, much less a plausible one. Armed with the enhanced understanding of time we get from philosophy and modern physics, can we make sense of time jumps like the ones described in these narratives?

According to the dynamic theory of time, we are constantly moving into the future as time passes. Even though the dynamic theory is quite mistaken as a description of the true nature of change, motion, and spacetime, it is natural to think of ourselves and the universe in dynamic terms. That makes future-directed movement through time easy to contemplate even though the whole basis for that conception of movement is a confusion. In relativity and the static theory of time, we do not literally move though time; we simply exist at different times doing different things. At best, we can speak in terms of a kind of continuous and

static worldline, or path through spacetime, for physical items like our own bodies (remember perdurantism from chapter 4). At each point this path seems directed toward the 'future' according to psychological asymmetries dictated by the entropic arrow. But there is no *movement* along our own worldline: A spacetime segment of ourselves simply exists, eternally, at each position. On the face of it, because the static theory leaves us with such an attenuated conception of motion though time, one might think that the static theory is a rocky place where the seed of time travel can find no purchase. If we don't move though time in the first place, what hope is there for fun variations on travel through time like traveling to the past in a time machine? But in fact, classical relativistic physics and its static account of time is where we find some of the best prospects for time travel. We have learned that the most plausible model of spacetime is the block model, which includes a timelessly existing span of events. If all actual events timelessly exist, then at least there is a potential destination for the time traveler. By contrast, the dynamic theory of time is not particularly friendly to time jumps like travel to the past. The version of dynamic theory known as presentism is particularly hostile to time travel: The presentist insists that past and future events are nonexistent; but then there would be nowhere—or should we say no *when*—for the time traveler to go!

Relativity describes different reference frames defined by relative velocities, each with its own perspective as to which events are simultaneous with others. One consequence is that what constitutes the *now* is, in a quite substantive sense, a matter of perspective. This seems to open the door to the notion of shifting from one now to another. As we shall see, the general theory of relativity seems to allow for some methods for jumping from one spacetime location to another via the manipulation of spacetime itself.

To examine the possibility of time travel in reality, as opposed to fiction, we need to determine first if it is even a logically coherent notion. If it is, then it makes sense to ask whether the laws of nature as we understand them might allow it. If they do allow it, then we can discuss whether any sort of time travel is actually feasible even if nature allows it in principle.

IS TIME TRAVEL LOGICALLY POSSIBLE?

When we ask whether time travel is possible, we can mean any of three different things, corresponding to three senses of "possibility": logical, physical, and practical. **Logical possibility** refers to whether the very notion of something implies a logical contradiction or paradoxical situation. For example, constructing a spherical cube is not logically possible, as it would mean producing an item with a set of properties no object could have all together. You can't build a spherical cube even if you are allowed to violate the laws of nature in the process. By contrast, though it may run contrary to the laws of nature for an unsupported pencil to hover in the air near the surface of the earth, this phenomenon implies no logical contradiction. An event is **physically possible** if its occurrence does not violate any natural laws. Logical possibility trumps physical possibility. Think of a spherical cube again: If we know a spherical cube is logically impossible, we don't need to investigate whether physics allows such a thing. Finally, there is what we might call **practical possibility** (or just feasibility): Practical possibility refers to what one can actually do given one's available resources. There are innumerable projects that would violate neither laws of logic nor of nature, but for which the means are simply not available. The construction of a chain of golden paper clips the length of the known

universe would not violate any laws of nature, but in the absence of the necessary time, energy, and materials the project is not feasible.

Because logical possibility trumps the other kinds, it makes sense to start with the question as to whether time travel would involve any logical contradictions. Time travel, at least as it is often represented in fiction, does seem to allow for logical paradox. The most often cited paradox is the **grandfather paradox**. Take the usual science fiction variety of time travel, involving a vehicle of some sort that takes you into the past. If this sort of time travel is possible, then it should be possible to go back in time and kill your own grandfather when he was a young boy, thereby preventing your own birth. But, of course, that would mean that you would not exist and be able to go back in time and kill your own grandfather, et cetera.

The grandfather paradox is a serious challenge to the logical possibility of time travel. The static theory of time entails that past and future events are unalterable because what we call past and future events are really just timelessly existing earlier and later events. You cannot change unchanging events; if time travel suggests you can, then so much the worse for time travel. If these concerns rule out time travel on logical grounds, then we don't even need to do a scientific study of the possibility of time travel; we would already know that it can't happen.

In fact, time travel and the static theory can be logically consistent. The static theory states, essentially, that what is done is done. The past BE just the way that it BE and there is no changing it. This does not necessarily rule out time travel, however, as this fact does not rule out the possibility that the past includes the actions of time travelers: Any past actions of time travelers simply BE timelessly included in the history of the world. This means that, even if people had traveled to their pasts, they couldn't have killed their own grandparents. Why? Because they *didn't*. This sounds odd, because,

if we grant the availability of a time machine and a pistol, why would one not be able to carry out the action in question? Philosopher David Lewis argued that this apparent oddness is just due to the fact that the issues relevant to deciding the truth of a claim that one "can" do something are context dependent. It may be perfectly true that, given the necessary resources and opportunity, you "can" murder another person; however, given that you exist at a later time, it is not the case that you "can" (in a different sense) kill your grandfather as a young boy. Even if you really went back in time with the intention of doing it, something must have intervened in the attempt (a misfire, perhaps, or change of heart), because your assassination attempt has already happened and was, evidently, unsuccessful. Even if science fiction time travel is possible, the fact is that your grandfather BE alive and you BE his grandchild. As physicist Brian Greene puts it, you can no more change such facts than you can change the value of a mathematical constant like pi.[1]

So the grandfather paradox, combined with the fixity of the past and present in the static theory, does not rule out the possibility of time travel; it just rules out inconsistent stories about how the world is throughout time.

Time travel narratives in fiction break down into a few categories, only some of which avoid logical paradox. The predominant source of conflict and drama in many time travel stories is the need to go back and change something in the past, or to prevent the past from being changed by a rogue actor. The protagonist must save the present timeline by changing something in the past. This is no good. While the Lewisian approach to the grandfather paradox allows for the concept of (timelessly) *affecting* the past, the prospect of *changing* the past is nonsense.

1. You can't change the future either. We'll get to that in the next chapter.

Sadly, a number of popular time travel stories involve changing the present by changing the past. Among popular films, this category includes *Back to the Future, Timecop, Déjà Vu,* and *Looper*. Given adequate suspension of disbelief, such stories can provide enjoyable narrative tension. But the central conceit in each is incoherent. These stories can tell us nothing about the nature of time.

Other fictional narratives get around time travel paradoxes by postulating a multiverse of either parallel or branching timelines. It's OK to change the past, because in so doing you have either visited or created an alternate history. This is fine for avoiding logical paradox, but calling it "time travel" is a misnomer: Rather, you have traveled to another universe that happens to look a lot like your universe did, say, five years ago. This is inter-universe travel, not time travel within your own universe of events. A prominent recent example of this strategy is *Avengers: Endgame*.

A few stories follow the one rule of logically consistent time travel narratives: What (timelessly) happens, (timelessly) happens. There is only one history, one timeline. The list of popular films that follow this critical rule includes *The Terminator, Twelve Monkeys, Harry Potter and the Prisoner of Azkaban, Los Cronocrímines, Predestination,* and *Interstellar*. In each of these narratives, there is only one version of events, even though characters travel through time and have influenced the past. In fact, in each case the sequence of events we see could not have taken place without these time-traveling activities. The time traveler in *The Terminator* returns to the past to rescue the mother of the person who later sends him back to the past for this purpose; he even helps conceive that person in the process. In *Harry Potter and the Prisoner of Azkaban,* Harry is rescued from soul-sucking

Dementors by a mysterious figure who turns out to have been Harry himself, who has traveled back in time to save himself so that he can go back in time to save himself.

Each of these narratives involves causal loops. The later event causes an earlier event, which itself helps bring about the later event. (This is sometimes called "bootstrapping".) One could even imagine the following scenario. A person in the year 2025 is handed the plans for creating a spacetime-warping device that makes travel to the past possible. She works for ten years building the device. She then travels back ten years to hand her earlier self the plans for the device. So who invented the time machine? Nobody. Is that a logical paradox? No. There is no logical contradiction in the story. The part that feels so weird is the existence of information (i.e., the plans for the device) that appears to have no explanation, no source. We expect facts to have explanations because that is what we are used to. But logic does not insist that everything have an explanation. What logic disdains is contradiction. Killing my grandfather in the past would mean I exist and do not exist. So we know that can't happen. But there is no contradiction in a causal loop—just oddity. Neither is there any physical law that disallows the spontaneous generation of information—just as no physical law prevents the (statistically unlikely) spontaneous organization of systems into lower-entropy states.

As long as we understand any time travel events to be timelessly included in the history of the world, and thus as part of the fixed continuum of events, time travel need not give rise to paradox. However, the logical possibility of time travel does not mean it is physically possible. Does nature, at least as we understand it, allow for time travel?

IS TIME TRAVEL PHYSICALLY POSSIBLE?

The standard science fiction scenario is the idea of a machine that transports you backward (or forward) through time. This scenario is problematic right off the bat because of the "double-occupancy problem", cited by Robin Le Poidevin and others. Suppose you press the button and the machine starts traveling back in time. The instant after you press the button, the machine traveling back in time must be occupying about the same space that the machine was occupying (while it was traveling forward in time) one microsecond before you pressed the button. But two solid items cannot occupy the same space at the same time.[2]

More promising are some other more scientifically grounded proposals about time travel relating its possibility closely to Einstein's general theory of relativity [GTR], which states that spacetime can itself be distorted in response to the presence or activity of matter. This effect has led some to suggest that time travel might be physically possible in relativistic spacetime. Late in his career, at Princeton, Einstein befriended the great mathematician Kurt Gödel. Their conversations led Gödel to work out the mathematics for a rapidly rotating GTR universe; in such a universe, spacetime would be so distorted that some light cones would tilt far enough over to allow travel into one's own past.

More recently, physicist Kip Thorne and others have argued that GTR also allows, in the presence of enough mass and energy, the

2. If you change the story and make it a machine that disappears completely and reappears in some other time, then you have a metaphysical problem about personhood and continuity: Namely, can the human occupant of the machine really be the same person after experiencing a complete discontinuity like that? Or would such a machine just have the effect of creating a duplicate of its passenger in the past? The latter would give you backward causation, but it would not constitute *transportation*.

formation of "wormholes"—tunnel-like distortions of spacetime that would allow passage from one area of space to another and which could be used, in theory, to travel to one's own past. (Thorne was a consultant for the film *Interstellar*.)

Proposals like these regarding the theoretical possibility of time travel are matters of ongoing scientific controversy. Even if such travel is physically possible, time travel relying on exotic spacetime configurations looks extremely impractical: The energy needed to distort spacetime in the ways described would be cosmic in scale. Nor is it uncontroversial that these proposals really do describe physically possible time travel methods. Einstein suggested that Gödel's model might not take into account other physical laws that would prevent time travel even in a rotating universe; others have argued that wormholes are inherently unstable, or could not be used for time travel for other physical reasons. So there is no consensus that backward time travel is physically possible. Philosopher Tim Maudlin describes the speculations of Gödel and Thorne as exercises in coming up with spacetime configurations that are mathematically consistent with GTR, but which would or could never actually take form. What is the relevance, he asks, of such alleged possibilities to our conception of time?

Should claims about the theoretical possibility of time travel hold up, the metaphysical implications would be very interesting. The physical possibility of time travel, even if it isn't technically feasible, would mean yet another blow to the dynamic theory of time. According to the dynamic theory, at any moment every actual event has the property of pastness, presence, or futurity. There is one path through time, with one past, one present, and one future. If one could travel to the past—even if only in principle—then past events would be potentially present for the traveler, present events future, and so on. But then such properties could not really be properties

of events: What is past, present, and future would have to be a subjective matter. Indeed, Gödel rejected the dynamic theory of time for this reason.

We would also have to rethink causation and the arrow of time. If time travel to the past is consistent with the laws of nature, then past events could be caused by future ones; this would lend further credence to the notion (examined in the previous chapter) that the one-way directionality of causality is not an inherent aspect of nature.

A QUESTION ABOUT TIME TRAVEL ASYMMETRY

So far we have talked only about travel into the past. Thanks to GTR (and direct observation), we know that it is pretty easy to 'slide' into the future simply by accelerating oneself around for a bit before returning to one's point of origin. It is a familiar consequence of the theory of relativity that someone departing from Earth on a fast spaceship, after accelerating away sharply and later returning, will find a difference between his or her clock and clocks back home. Imagine a pair of twins, one of whom departs for just such a journey. Upon returning, she will find that less time has 'passed' for her than for her twin back on Earth.

This effect of acceleration has been confirmed many times over by experiment. A very accurate atomic clock on board an ordinary passenger jet will noticeably diverge from its twin back on the ground after a few flights, precisely to the degree predicted under relativity. This makes anyone who goes on a plane trip a time traveler into the future, even if the time difference upon return is only a tiny fraction of a second.

One moderately helpful way to understand this bizarre phenomenon is by thinking of each of us as having a distinct path through spacetime. Each of us traverses the same amount of spacetime over time, but not necessarily in the same way. The more distance one traverses in the spatial dimension of spacetime, the less of the temporal dimension one will have traveled and vice versa. The twin taking the trip winds up measuring the passage of time from the standpoint of two different frames of reference during her trip, instead of one. The respective paths through spacetime for our separated twins could be represented as shown in figure 7.1.

Putting it roughly (and from the stationary twin's perspective only), the traveling twin's nonlinear path through spacetime takes her through more of the spatial dimension but less of the temporal dimension than her twin.[3] She ages less while covering more distance.

Slides into the future, then, are not only physically possible but quite feasible—and even routine on extremely small scales. In contrast, travel into the past, even if logically and physically possible, does not appear to be feasible in any way currently imaginable. In considering this fact, Barry Dainton has asked a good question: If the static theory of time is true, why should a forward slide into the future be so much easier than a backward jump into the past? If the past and future are just as real as the present, and jumps to the future are routine, why is travel to the past either wildly difficult or physically impossible? What makes the past and future so different

3. Note that the space and time axes are labeled on behalf of the stationary twin only; the traveling twin looks at space and time differently by virtue of her different reference frame(s), which of course is essential to the whole idea of relativity. Figure adapted, courtesy of Wikipedia user Acdx, based on file Twin paradox Minkowski diagram.png. Accessed October 22, 2012, at http://en.wikipedia.org/w/index.php?title=File:Twin_Paradox_MinkowskI_Diagram.svg.

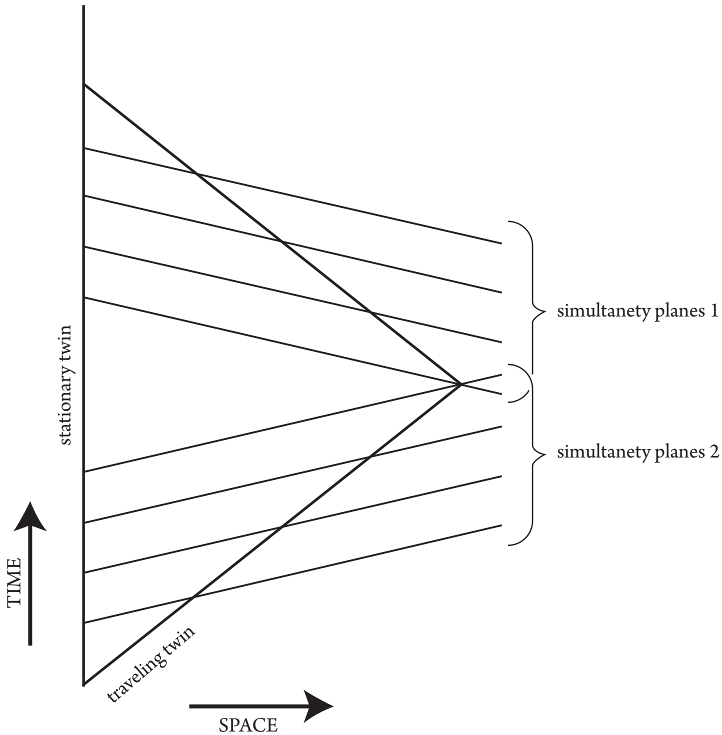

Figure 7.1. Each plane of simultaneity represents what spatially separated events the traveling twin would measure as simultaneous with each other.

in terms of *accessibility* if they are just parts of a static spacetime continuum?

Despite the necessarily speculative character of any discussion of time travel, it is a useful area of examination because it gets us to ask some good questions, like Dainton's question about the asymmetrical nature of time travel. It is a question that suggests we maintain some skepticism that the static theory fully captures the nature of time—at least until we understand more.

There is yet another kind of alleged asymmetry between past and future that accounts for a common claim about the inadequacy of the static theory: Though we may all agree that what is done is done, human freedom (some might argue) requires an open future of genuine alternative, undetermined possibilities. The static theory appears to be incompatible with freedom because it does not allow changes to any part of the universe's timeline—including the future. Consequently, if we are free to change the future, the static theory must be wrong. Whether this line of attack really does give us a reason to think that the static theory is wrong is the subject of the next chapter.

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Chapter 8

Time and Freedom

Is the future already written? According to the static theory of time, all so-called 'future' events timelessly BE, distributed over the eternal block of spacetime. Because static theory says that all facts just are what they are, with no distinction between the future and the 'settled' past, it seems to imply that we cannot make genuine choices: If there is only one way for things to go, then we can't choose otherwise than we in fact do. How can we be free if we can't choose otherwise than we do? Is the impossibility of free will really a consequence of the static theory of time? (And, if so, would this consequence be a reason to reject that theory?)

ARISTOTLE AND THE SEA BATTLE

Fatalism is the generic term for the idea that human decision-making is irrelevant because the future somehow involves no genuine alternative possibilities. In the philosophical context, this does not refer to active intervention on the part of any supernatural forces like the mythological Greek Fates, but rather to certain logical, metaphysical, or theological problems with the notion of an open future. Fatalism conflicts with a deeply held intuition that

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we can sometimes choose between genuine alternatives, and thus that some future events are contingent on our decisions. The static theory of time is harder to accept if it requires us to embrace fatalism. Defenders of the dynamic theory of time sometimes argue against the static theory precisely on this basis: Some claim that the static theory can't be right because human beings have free will, and free will requires an open future. Proponents of the dynamic theory correctly point out that, on the static theory of time, all history past, present, and future is written, down to the last detail: Whatever 'will' happen timelessly *happens*. (Remember, this is strongly implied by relativity, according to which events that lie in your future at any moment lie in the past according to a different and equally valid frame of reference. So all events, including the ones you don't know about yet, have already 'happened' just as conclusively as the ones that you already know about.) At first glance, this appears to rule out a future of different, real possibilities that can be resolved one way or the other purely by one's choices.

A simpler version of fatalism, dating back to Aristotle, refers to a logical conundrum about future possibilities. His version of fatalism is **logical fatalism**, which we might also simply call generic philosophical fatalism. In one text, Aristotle considers a puzzle about whether there are any genuine possible, yet non-actual, events. Take the following two propositions:

1. There will be a sea battle tomorrow.
2. There will not be a sea battle tomorrow.

Normally, we would like to say that each of these propositions about tomorrow's battle expresses a genuine possibility, up until the day arrives and the weather either permits the battle or forces the respective navies to delay. Upon reflection, however, this is not so

clear-cut. A widely accepted logical rule dictates that every meaningful statement of fact must be either true or false. This is called the **principle of bivalence**. Another widely accepted rule states that no proposition and its negation can each be true at the same time; this is the **principle of non-contradiction**. If we accept both these rules, we must concede that, the day before the expected battle, one of the propositions about the sea battle's occurrence is now true and the other is false—even though we don't know which as of yet. Of course, the same will be true for any other proposition about the future. The fatalist concludes from this that any event in the future that turns out not to come to pass was never really a possibility in the first place, no matter how plausible or even likely it seemed; and any event that does occur could not possibly have failed to occur. This would mean that nothing that will happen in the future could happen otherwise. Logical fatalism does not depend on particular account of the nature of time; nor does it refer to any *causal* necessity attaching to future events, in that the issue is not that the laws of nature dictate, given the current situation, what must happen next. The issue is whether logic permits two contradictory propositions about the future to each be genuinely possible. The key consequence of logical fatalism pertains to human freedom of choice and action. It would appear that, if logical fatalism is true, then we cannot be free: If it is true now that any given future event definitely will (or will not) happen, then there is no way for us to change the future course of events.

Aristotle rejected this result. Logical fatalism seems to make a hash of the usual distinction between logically necessary truths (like "2 + 2 = 4") and contingent truths (like "A sea battle takes place") by suggesting that only one sequence of events is really possible at a given moment. Aristotle's answer was that propositions about the future constitute an exception to the principle of bivalence.

Contrary propositions about the future, he explained, describe only potential situations, not actual ones. It is true that one or the other of two contrary propositions about the future must be true at some point, but neither must be true now.

Aristotle's picture coincides with what can only be understood as the standard, non-philosophical view that most people have about human freedom. According to this standpoint, human choices play a role in shaping as yet non-actualized future events. The future is not established or actualized until choices are made and their consequences play out. Human choices are based on reasons, but our choices can go either way until we decide which reasons are most important.

There are a few possible objections to Aristotle's solution.[1] The biggest problem has to do with its presumptions about time. Obviously, Aristotle's answer presumes the dynamic theory of time. He assumes a genuine difference between the past and the future, in that past facts are settled, whereas future facts are merely potential. Future facts genuinely change from having merely potential status to having actual status thanks to human choices and the passage of time.

1. One technical issue with Aristotle's answer is that it seems to make accurate prediction impossible. We would like to say that if one predicts a sea battle, and it comes to pass, then one spoke truly about the future battle at the time the prediction was made. But Aristotle's solution, because it describes future events as mere contingencies, means that, though you can truly say that a given future event is possible, you can't speak truly or falsely about its actually coming to be in advance of its coming to be. Yet we tend to think one can be congratulated upon making an accurate prediction—indeed, betting on sports is predicated on this idea. Philosopher John MacFarlane replies that the truth value of a prediction is context-dependent: Whether it should be thought of as having a truth value depends on the context in which it is being assessed. He claims, in other words, that a statement like "There will be a sea battle tomorrow" is neither true nor false before the battle, but it can be retroactively assessed for accuracy after the fact. It is not clear who is right about this, but it is a moot point if there are other, compelling reasons to reject the dynamic theory of time (as there seem to be).

This answer is undermined by what we have said in favor of the static theory of time. On the static theory, there is no actual-versus-potential distinction between so-called past and so-called future events. Everything happens timelessly, somewhere in the eternal block of spacetime. Every event (as we know from relativity) can be both past and future according to different observers—and no such perspective is privileged. Every event BE just the way that it BE. There is no open future of yet-undetermined alternate possibilities. We shall call this position **metaphysical fatalism**, which supports the key claim of logical fatalism: namely, that all meaningful statements of fact are either true or false—including statements about what looks like the future from one's perspective at the time of utterance. Metaphysical fatalism derives not from some generic application of logical principles but from the static theory's conclusions about the status of events in time. That the static theory is fatalist in this way shouldn't come as a big surprise. We already know that we cannot change the past. The static theory rejects intrinsic temporal determinations like past, present, and future, holding that such designations for events are observer dependent. Events are earlier or later in relation to each other but do not change their status, as the dynamic theorist would maintain, as they allegedly 'become' present. There is nothing intrinsically special about the difference between an event being future and an event being past. The rule about time travel is that you can't change the past; for exactly the same reasons, the rule about free will is that you can't change the future either. What (timelessly) happens, (timelessly) happens.

If the sea battle takes place on a given date, then it always does so. Whether the battle takes place in the future, present, or past is just a matter of one observer's perspective at the moment of considering that event. There are no merely potential events in the sense in which Aristotle is using the term. The occurrence (or non-occurrence) of

the battle is not *logically* necessary in the sense that the contrary state of affairs would involve a logical contradiction, but, because of the nature of time, the truth of the correct statement about the battle is nonetheless assured no matter when it is uttered. Aristotle's answer stands or falls with the dynamic theory of time; and we have seen in chapter 4 that neither logic nor physics favors that theory. If the static theory is correct, then the application of the principle of bivalence to propositions about the future seems appropriate. The result is metaphysical fatalism.

Many would strongly resist the conclusion that the future is as set in stone as the past, finding the implications for human agency repugnant. Metaphysical fatalism might be taken to suggest that human influence on history is not possible: Whatever we do, later events will be what they will be (because they timelessly BE what they BE). Yet surely there is some sense in which our choices can influence the course of events; history has played out a certain way, but things could have gone differently had different choices been made. Unlike truths of mathematics, facts about the course of events are not necessary truths. Can the static theory account for contingency and the role of human choice in events?

Happily, yes. The static theorist is not committed to the complete irrelevance of choice. Philosopher L. Nathan Oaklander agrees with the static theory of time but denies that fatalism is a consequence of that theory. He agrees that the statement that a given event occurs, if true, is timelessly true. But this does not mean that the truth of any such fact cannot depend on a choice someone makes at some moment. Take the timeless fact that Napoleon signs the Concordat of 1801. Oaklander points out that there is nothing preventing the static theorist from acknowledging the timeless fact of this event, while attributing the existence of this fact to a decision made by Napoleon, shortly before the signing, to enter into an alliance with

the Roman Catholic Church. The principle of bivalence requires that the statement "Napoleon signs the Concordat" is timelessly true, but it does not require the cause of the truth of that statement to be in effect in advance of Napoleon's decision. Napoleon's decision is a legitimate part of the explanation for the event: If he had decided differently, it wouldn't have happened. So we can agree with the metaphysical fatalist that all statements about the future are either true or false, but we need not conclude that we have no influence on the future. In this way, static theorists can eat their cake and have it too: They can uphold the timeless truth of all facts without requiring that we have no role to play in the course of events.

Yet it must be noted that this answer does not exactly clear the way for free will. Regardless of logical or metaphysical fatalism, and regardless of the static-dynamic debate, we still face issues with the *causal* necessitation of events.

CAUSAL DETERMINISM

Greco-Phoenician philosopher Chrysippus of Soli (third century BCE) was a highly regarded logician; he also wrote about causation, freedom, and virtue. In relation to his interest in freedom, he discussed both fatalism and **determinism**. Fatalism just makes the point that, if all statements about the future are timelessly either true or false, then all events must therefore occur just as they do—regardless of whether they occur in accordance with natural laws. Determinism is a doctrine that bears a superficial resemblance to fatalism, but involves a different issue altogether: causal, or natural, necessitation. Determinism states that all events have a cause and thus that all events are determined by a chain of causes going back uninterruptedly into the past. The causal determination of all events

appears to be incompatible with the notion of having genuine control over one's own choices. According to determinism, given the way the past is, plus the laws of nature, any event must unfold the way that it does. Human decisions are just events in the world like any other, so they are determined by past circumstances—whether internal or external to the agent—just like any other events. Because persons do not control either the past or the laws of nature, they cannot ultimately control their own choices. Note that this position about the causal determination of choices is not specific to either the dynamic or static theory of time, as each theory embraces the notion of a universe governed by natural laws.

The determinist standpoint is commonly linked to **scientific naturalism**, which is the position that all events are natural (as opposed to supernatural) and so are explicable according to natural laws. French mathematician and astronomer Pierre-Simon Laplace, when asked by Napoleon about the role of God in his theory of celestial mechanics, famously answered, "Sire, I have no need of that hypothesis." If all events are natural, and natural events take place in accordance with natural laws, then all events are determined by prior causes according to those laws. Laplace illustrated this proposal through the thought experiment of a hypothetical being who knows everything there is to know about the current state of the universe, as well as everything there is to know about the laws of nature. If naturalism is true (as Laplace believed), then this hypothetical omniscient being would be able to predict the future with complete accuracy:

> We may regard the present state of the universe as the effect of its past and the cause of its future. An intellect that at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this

> intellect were also vast enough to submit these data to analysis, it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes.

Determinism thus follows from naturalism. Causal determinism may be an even greater challenge to free will than fatalism. Unlike fatalism, determinism is a challenge to free will even if Aristotle is right and the dynamic theory of time is correct: If all events proceed from prior causes, it wouldn't matter if time passes and future events really are non-actualized now, because future events are naturally predetermined by the current state of things. Given the way things were in the past, plus the laws of nature, our own future choices are fully determined by past events (see figure 8.1).

Causal determinism has equal impact on the static theorist's account of free will. Oaklander was able to describe the compatibility of free will with the static theory's metaphysical fatalism by noting that there is nothing stopping us from explaining the timeless fact of an event by reference to a decision made at a time. This answer, however, says nothing about whether causal factors ultimately beyond the individual's control made that decision itself inevitable.

Laplace's omniscient predictor is just an illustration of an idea quite familiar to Chrysippus, who accepted both causal determinism and logical fatalism. As with Aristotle, Chrysippus' concern about the possibility of human freedom was based on his concern about moral responsibility. Like fatalism, determinism seems to imply that we are not free: If all events are determined by natural laws, and human choices are events in the world, then our choices themselves are ultimately determined by prior events over which we

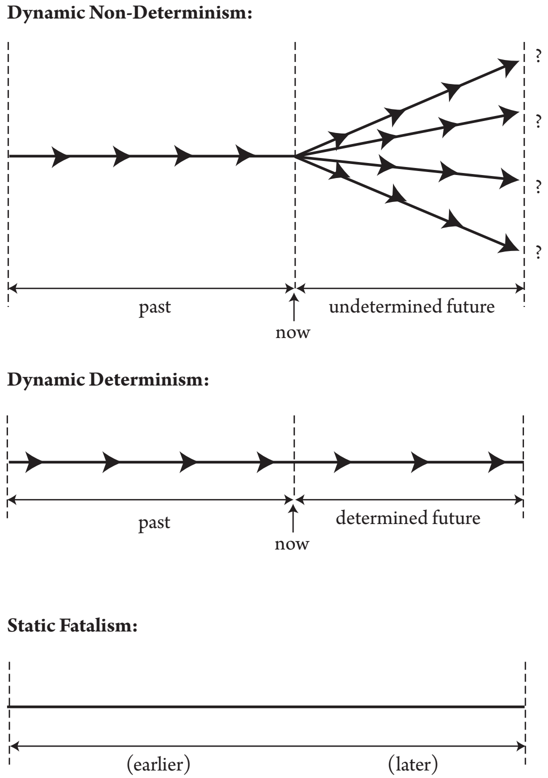

Figure 8.1.

have no control.[2] This situation seems to rule out the possibility of moral responsibility.

2. I am ignoring quantum mechanics, some interpretations of which suggest that unobserved events are properly described in terms of probability only. The sense in which indeterminacy rules in quantum physics is unlikely to have any relevance to freedom. Even if it could be shown that our choices derive from some sort of undetermined, random quantum fluctuation, this would do nothing to show that we have determinative control over our actions: Random events are by definition uncontrollable, so we lack control either way.

AN ANSWER TO BOTH FATALISM AND DETERMINISM: COMPATIBILISM

In response, Chrysippus proposed that free will, properly understood, is compatible with determinism. His answer, called **compatibilism**, remains the most popular philosophical answer to causal determinism. Chrysippus distinguished between an event that is causally determined to occur and one that is logically necessary. Logical necessity has to do with the converse of a proposition implying a logical contradiction. An object cannot be round and square at the same time; my bicycle cannot be in the backyard and not in the backyard at the same time. Human choices are not logically necessary in this sense, even if they are causally determined to occur. Chrysippus goes on to point out that we can distinguish between events that we help to bring about and events that are brought about by external causes alone. An action is free, he argues, if it stems from one's own intentions. Intentional actions are free in the sense that jumping off a cliff is a free act, whereas being pushed off a cliff is not. Of course, in a deterministic universe the fact that one was going to have the intention to jump is causally predetermined.[3] Nevertheless, the proponent of compatibilism can distinguish between those events one can control in the sense that they occur *because one wants them to*, versus those that are not under one's control in that same sense. Chrysippus—like many modern compatibilists—claims that the concept of moral responsibility applies to actions based on one's own intentions, even while accepting the prior determination of those very intentions. This, the

3. Again, quantum indeterminacy and any other randomness would be irrelevant here: A universe with genuinely random rather than predetermined events offers no more control over events than a fully deterministic one.

compatibilist would argue, is just what we mean by "freedom" as we actually use the term. As David Hume put it,

> For what is meant by liberty, when applied to voluntary actions? We cannot surely mean that actions have so little connection with motives, inclinations, and circumstances, that one does not follow with a certain degree of uniformity from the other, and that one affords no inference by which we can conclude the existence of the other. For these are plain and acknowledged matters of fact. By liberty, then, we can only mean a power of acting or not acting, according to the determinations of the will; that is, if we choose to remain at rest, we may; if we choose to move, we also may. Now this hypothetical liberty is universally allowed to belong to everyone who is not a prisoner and in chains.

Free actions are those that conform to the agent's inclinations and situation. An action that is literally unpredictable, even with full knowledge of the agent's intentions, values, desires, and circumstances, is an action that by definition is not under the agent's control. Actions that are predictable (given full information of all relevant facts about the agent and his or her circumstances) are the *only* ones that could qualify as free.

Leibniz also embraced compatibilism; in his case it was in response to **theological fatalism**, a problem about freedom specific to some theists. Theological fatalism is (or should be) of concern to believers in an omniscient deity. If God is omniscient, then he or she has perfect foreknowledge of everything we do. If God has perfect foreknowledge, then our future choices cannot be otherwise than they will be. How, then, can we be considered free? Even supposing the dynamic theory of time were correct, if God exists and has perfect foreknowledge then we don't have an open future in the sense

of having genuine alternative options: The way God foresees things happening is the way that they will go.

Much like Chrysippus' answer to determinism, Leibniz's answer to theological fatalism was to distinguish between its being logically necessary that one do something and its being merely contingently true—yet perfectly predictable—that one will do it. God's foreknowledge just means that He knows what we are going to choose to do; Leibniz argues that this perfect predictability does not necessitate our actions because it remains *logically* possible that we could do otherwise.

Unfortunately for Leibniz, compatibilism doesn't work very well in a theological context if the point is to defend individual moral responsibility: According to Leibniz's own understanding of things, God would be the one who intentionally created each of us with just such a nature that under the circumstances—also preordained by God—we would do exactly as predicted. How could God then turn around and hold us responsible for the consequences? For this reason, theists other than Leibniz have almost always rejected compatibilism in favor of a stronger notion of free will.

This particular problem for the theist aside, compatibilism can be deployed in response to the static theorist's metaphysical fatalism: We simply distinguish between timelessly existing events in which human intentions play a role and ones in which they do not. According to metaphysical fatalism, we cannot change the future any more than we can change the past. Yet we can *affect* the future. We can distinguish between events that are brought about by human intentional action and ones that are not.

The one and only history is the one in which Napoleon signs the Concordat in 1801; but it is also the case that he signed it because he wanted to. One cannot explain the events of 1801 without including this decision on his part. Even though there is only one version of

history, one's choices help shape that history. The universe is like a book, and we are characters in the book whose decisions shape the narrative. Every human decision is part of the story of the universe. But the story does not change. And the book is written by no one except the laws of nature plus the conditions found at the low entropy end of the timeline.

Do our choices matter? Our choices matter in the same way that what time it is now matters. What time it is now matters to us at this moment because it affects our situation now. As human beings we make positive and negative evaluations of human choices. The universe doesn't care about our moral choices any more than it cares about what time it is now; the importance, significance, or value of something is always about the relationship between the subject and the world. "Objective value" is an oxymoron anyway: Something has value only because it is valued. What time it is now matters only because it matters to us now; what choices people make matter because the consequences of those choices matter to us. The compatibilist is not fazed by questions about whether his or her decisions 'matter' in some way independently of their significance for the person or persons involved in the situation.

The defender of free will typically replies that the compatibilist conception of freedom is too weak: It doesn't live up to the most natural understanding of what it takes to be free in one's choices. Kant famously characterized compatibilist freedom as a "wretched subterfuge" and called it "the freedom of the turnspit". Like many others, he felt that any conception of freedom that does not allow for a choice between two genuine, undetermined possibilities is not capturing what we commonly mean by freedom. Kant's fellow German, Arthur Schopenhauer, succinctly expressed the paradox within compatibilism with the aphorism "Man can do what he wills but he cannot will what he wills."

So much the worse for the common notion of freedom, reply compatibilists. A closer look at any non-compatibilist version of freedom reveals a fundamental conceptual confusion. The doctrine of non-compatibilist, or **libertarian**, freedom states that a free act is a truly undetermined event that itself determines some aspect of a hitherto open future. This is simply incoherent. The libertarian's notion of freedom says that free acts are both undetermined *and* under one's control, but these characteristics are incompatible. The libertarian notion of a free action seems to be, as Oaklander puts it, "one that is caused by the person or self; a substantial agent whose spontaneous act of creation lies outside the sphere of scientific predictability and external causality." This free action must be strictly unpredictable, yet not uncaused in the sense in which a random or chance event is uncaused. The libertarian wants actions that are explicable in terms of the reasons the agent is acting on, yet not determined in the Laplacian sense. This is magical thinking. There just isn't any space for an action to be both based on reasons and causally inexplicable. If an agent is acting based on reasons, then there will be a causal story as to why the agent has come to have those reasons. If the agent is not acting on the basis of reasons, then his or her actions are not deliberate or intentional—so once again the agent's actions are not free in the libertarian sense. If one's actions are determined neither by one's internal state *nor* by some outside force, the only alternative is that they are randomly occurring, uncontrolled events. Events that are uncaused are events that have happened by chance; there is no other option. Actions due to chance are not free on anybody's view. There is no libertarian option. It's not like we *could* have been free in the libertarian sense under different circumstances, like there is a possible world where we had three arms or the ability to breathe underwater. The problem with the libertarian's stronger

notion of freedom is not only that it requires the passage of time and an open future, but also that it is self-contradictory.

Compatibilist freedom is the only option. It is the only version of freedom available in any universe. Whether the universe is static or dynamic, deterministic or indeterministic, this is the only kind of claim to freedom we can make. This is a contentious result for a lot of people, mainly because it is not at all clear that compatibilism leaves room for a robust sense of moral responsibility. How can we hold, say, a criminal responsible for his or her actions if we acknowledge that the intentions behind those actions were entirely a product of his or her genetics, history, and circumstances?

Indeed, punishment purely for the sake of moral retribution is called into question by compatibilism. For the compatibilist, however, there is still room for punishment for the sake of deterrence and rehabilitation, concepts that are consistent with the notion of external influences on action—in fact, they depend on it.

Actually, insofar as progressive political egalitarians tend to favor deterrence and rehabilitation over punishment for its own sake, the arguments for compatibilism at the same time constitute an argument for progressive positions on crime and punishment. The same could be said for progressive attitudes toward equalization of economic and educational opportunity: These also stress the impact of history and circumstance on both choices and outcomes.

To this the political conservative typically replies that society cannot function without people having a strong sense of responsibility over their own lives. You can't just have everyone blaming his or her past for everything he or she does wrong. One might well argue that society is better off if everyone believes in a stronger sort of freedom, even if that sort of freedom is logically incoherent. This actually seems plausible, which raises a disturbing question: Could it be that it is more important to preserve a misconception about

freedom than to know the truth? Are there other areas where this principle applies—where a misconception is more useful than the truth? Perhaps it is better for everyone to believe in objective moral laws, even if a philosophical justification for such laws is not available. Maybe it would be better if everyone believed in a god who will punish misbehavior, even if we have no evidence for the existence of such a being. Maybe it would be better if everyone embraced the dynamic theory of time, even though that theory is mistaken.

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Chapter 9

The Beginning of Time

Has the universe been around forever, or did it have a beginning? What is the relationship between the beginning of the universe and the beginning of time? If the universe had a beginning, does that mean there was a time when it didn't exist? Or did time begin when the universe did? Two very different research methodologies have been applied to addressing such questions. Relationists (represented here by Aristotle and Leibniz) and idealists (represented by Kant) have each tried to use reason alone to work out the possibility of a beginning of time. Realists (represented by some modern physical cosmologists) rely on empirical methodology—albeit supplemented by a lot of conjecture—in arriving at some ideas on the subject.

RELATIONISM: ARISTOTLE AND ETERNAL CHANGE

For Aristotle, time is just the measure of change. On this basis he denied that there can be a beginning or end to time. According to Aristotle, although there can be a first moment of a particular sequence of changes, there can be no ultimate beginning or end to

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change itself. For any change to take place, the conditions of change must be in place—and that requires a prior process that brought the conditions of change into place. Similarly for an end to change: Any end to a process of change itself represents a process the end of which requires a further change-ending event, and so on. As time is just the measure of change, if there cannot be a first or last change then there cannot be a beginning or end to time. Recall that, for Aristotle, a moment of time is an abstraction, defined only by its role in separating a duration into smaller ones. By its very nature, therefore, any moment of time can only itself be a midpoint between an earlier and a later time. So both time and the universe it describes are eternal.

It is indeed hard to accept the notion of an absolute beginning of time. Wouldn't the universe have to be preceded by something that gives rise to it? If so, then a beginning of the universe would not be the beginning of time itself: It would just be something that happens in time.

It is interesting to note that one of history's other great temporal relationists came to the opposite conclusion. Like Aristotle, Leibniz believed that time is just a relation—an intellectual abstraction we employ in conceptualizing what is real. Motivated by a theological perspective that demands a beginning to (i.e., the divine creation of) the world, Leibniz argued that the universe, and thus time itself, began with the first event or state of affairs. Unlike Aristotle, he did not feel that a beginning to time implied a nonsensical time before time. If the universe begins, then time does.

In the *Leibniz-Clarke Correspondence,* Newton's ally, Samuel Clarke, complained that Leibniz can't have it both ways: You can't say that the universe was created, but not created *at some time*. Clarke also claimed that Leibniz limits God's abilities. For the relationist, time is created when the universe is, because time is just a function

of events. But then it would not have been in God's power to create the universe at a different time. Leibniz responded that there is a way for the universe to have been around longer: It would have been around longer, in the relationist sense of the word, had God simply put more events into it. By way of explanation, Leibniz supplies his own diagram (reproduced in figure 9.1). The actual universe begins with events at A-B-C-D; had God wanted more to happen, He could have created some more events leading up to A-B-C-D. Events at R-S-A-B are causally related to events at A-B-C-D; and temporal succession (for Leibniz) is just what we call the relation between non-coexisting, causally related events. Creating a universe with more causally related events in it would amount to creating the universe earlier. Thus, Leibniz claims, the relationist can have a creation story without an absolute time at which the creation takes place.

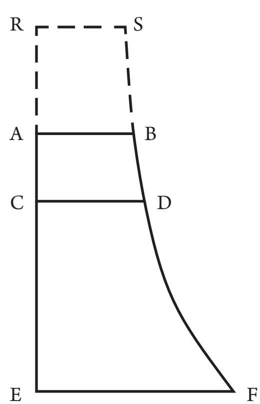

Figure 9.1.

IDEALISM: KANT'S DICHOTOMY

Immanuel Kant rejected relationism because we unavoidably think of time as a quantity—something there can be more or less of—rather than as a kind of relation. As he argued, the relationist notion of having more time only by virtue of having more events just does not capture the role it plays in our sensibility. Although he was not a realist like Newton, Kant did agree that we intuitively *represent* time as a sort of Newtonian container for events, which inevitably gives rise to the question as to whether the container is finite or infinite.

Kant addresses the issue of the temporal limits of the universe in his characteristically clever fashion. The section of the *Critique of Pure Reason* in which he tackles the problem is called "The Antinomy of Pure Reason". An **antinomy** is a situation in which you are confronted with two compelling and logically valid arguments for contradictory conclusions. Any situation like this would entail that one or both arguments had a false premise. Kant thought that, given certain common (but false) presuppositions, one could come up with a logically valid argument both for *and* against the conclusion that the universe is unbounded in time. Exposing the contradiction is intended to point the way to dispensing with those false presuppositions that make the antinomy possible.

He presents each of these contrary arguments before showing how to resolve the apparent contradiction. First, he offers what he considers a valid proof that the world must have had a beginning in time. "For if one assumes", he begins, "that the world has no beginning in time, then up to every given point in time an eternity has elapsed and hence an infinite series of states of the world, each following another, has passed away." If the world has no beginning in time, then at any point an infinite number of minutes must have

actually, literally elapsed. But an infinite sequence of equal and finite time periods cannot be completed. If an infinite amount of distance must be crossed to get someplace, then that place cannot be reached; if an infinite amount of time has to pass for something to happen, then it will never happen. We cannot now be experiencing a time that sits at the end of an eternity, because eternity doesn't end.[1] Kant claims that this line of reasoning conclusively shows that the world can only have been around for a finite length of time. (He was not thinking in terms of the static theory of time. We shall set aside for the moment what effect the static theory might have on this line of reasoning.)

Kant contrasts his argument for the finiteness of the world in time with another allegedly drop-dead argument for the *opposite* conclusion. This time, he asks us to suppose that the universe does have a beginning in time. Just as Aristotle had said, there seems to be an intractable conceptual incoherency in the notion of a first time. How can you have a moment without a moment preceding it? This is just as absurd as supposing an edge, or boundary, to space: How can you have a spatial boundary without a space on the other side of it? As Kant argues, bounded time would mean that

> there must be a preceding time in which the world was not, i.e., an empty time. But now no arising of any sort of thing is possible in an empty time, because no part of such a time has, in itself, prior to another part, any distinguishing condition of its existence rather than its non-existence (whether one assumes that it

1. This argument closely follows Persian-Arabic philosopher al-Ghazali's eleventh-century argument against infinite past time; Kant may have been influenced by al-Ghazali's ideas through Leibniz.

> comes to be of itself or through another cause). (Guyer/Wood, trans.)

Kant notes that a time before any universe or events in the universe—an "empty time"—would be a time with no distinguishing features. If literally nothing is going on, then what would explain why the universe would come into existence, or the first event occur, at *that* very moment, rather than at some other empty time?[2] This line of reasoning, Kant claims, appears to conclusively show that the universe can have had no beginning in time.

A pair of valid arguments leading to contrary conclusions leaves us with a dilemma that must be resolved. If each of these arguments is logically valid, one must be based on a false premise. In fact, Kant argues, they each share the same false underlying premise: namely, that time describes something real in itself. If time describes something real in itself, then there would be a fact of the matter as to whether the universe is infinite in time. But neither answer to this question makes any sense. Kant's solution to the conundrum about the extent of time is temporal idealism. In other words, his answer is "none of the above": Time is neither an infinite nor a finite quantity because it neither is a quantity unto itself nor describes a quantity of something else (i.e., change). The problem with arguing about the extent of time is that time does not have an extent; time is just the form in which we experience events, rather than a real bounded or unbounded container for events.

2. This question is intended to apply to both the creationist and the atheist points of view. In his parenthetical remark in the above passage, Kant observes that this would be a problem if the universe "comes to be of itself", because there would be no cause for things to happen at any particular moment of empty time. It is equally a problem if the universe comes to be "through another cause": As Augustine had pointed out, a divine creator would have no reason to act at any particular moment of empty time over any other.

REALISM: BIG BANG PHYSICS

Of course, relationist and idealist conclusions about the extent of time have only as much appeal as the relationist and idealist analyses of time do. As we have seen, relativistic physics can be linked to spacetime realism—admittedly, with a number of substantial caveats having to do with the incomplete state of physics, along with deep issues regarding scientific realism versus. scientific instrumentalism. What can contemporary cosmology say with confidence about the origin of spacetime?

Thanks to the work of astronomer Edwin Hubble and others beginning in the early twentieth century, it has been firmly established that the universe is expanding; further, its expansion can be traced back to a highly compressed state that experienced a rapid inflationary period (about 13.8 billion years ago) called the **Big Bang**. Until recently, the Big Bang and its immediate sequelae seemed to be beyond physical description (much less explanation), because relativistic physics does not have the methodological resources to describe anything in such a highly energetic state. However, over the last few decades something close to a consensus has developed among cosmologists on **cosmic inflation theory**, which does a good job of accounting for what happened a tiny fraction of a second *after* the Big Bang. Inflation theory describes a very brief but enormous expansion of spacetime itself, eventually slowing and cooling into what we can observe of the early universe just a few hundred thousand years later. This extremely rapid early expansion of the universe would explain its continuing expansion, the large-scale geometric 'flatness' of spacetime, and the homogeneity of regions of the observable universe too far apart to have directly affected each other.

This gives us a pretty good grasp of what was happening with the very early universe. But it is not clear whether this information would do anything to address questions that Aristotle and Kant raised about the thesis that the universe had a beginning. Was the Big Bang the beginning of everything? Was it the beginning of time itself? If the Big Bang was the beginning of time, then time *had* a beginning. One lesson learned from Aristotle is that a beginning of time *in* time doesn't make any sense. To make sense, it seems, the Big Bang needs to be thought of as a beginning *to* time rather than a beginning *in* time. Though it remains to be seen whether we can make sense of a beginning *to* time either.

One idea that might be thought to address this problem is the insane yet surprisingly plausible **multiverse theory**, wherein our universe is a semi-discrete development within an unimaginably larger, expanding reality mostly inaccessible to us. Multiverse theory links up to the Big Bang model of the universe via the **chaotic inflation** model of universe expansion. This model proposes that the total, larger universe is characterized by ongoing massive inflation and chaotic fluctuations, leading to different parts of this larger universe (i.e., the multiverse) having different characteristics and rates of expansion. On this view, our own universe is a bubble of relative stability that coalesced within a vast and never-ending cosmic expansion. Other sub-universes, potentially with different fundamental natural laws, are space-like separated from ours (and thus exist in the same reality as ours).[3] But the space between them is expanding so rapidly that, even though our observable universe is expanding too, none of them are ever likely to encounter each

3. Multiverse theory is unrelated to notions about parallel realities or the many-worlds interpretation of quantum mechanics. We are not talking about completely separate realities, but rather a more ordinary notion of a larger system that is out there in *our* reality—just inaccessible to us thanks to distance and rapid expansion.

other.[4] Of particular significance for our purposes is the fact that the multiverse model (as physicist Sean Carroll has argued) would account for the otherwise wildly unlikely low-entropy state of our early universe discussed in chapter 6: Baby universes like ours are low-entropy regions of a system so large and complex that little oddities like our corner of the cosmos are to be expected to pop up many times over.

Multiverse theory is humbling: In addition to reminding us of our own seeming insignificance in a vast universe, this theory describes that awesome immensity as just a little multiverse fart. More to the point, the multiverse idea is not necessarily determinative when it comes to understanding time. Any big philosophical questions about the extent of the universe would seem to just get relocated to the multiverse. We could still ask whether the *multiverse* had a beginning or not—and whether this means time had a beginning too. Could the multiverse have existed forever? What about the issue of the impossibility of an actual elapsed infinity of time?

On the static block universe model, time does not "elapse", so actual elapsed infinities are not really an issue. For this reason many physicists are untroubled by a universe that has existed forever. Others continue to discuss the notion of reality inception. Physicists like Paul Davies and Alan Guth have proposed that the multiverse emerged spontaneously and randomly out of, literally, nothing. The rules of quantum mechanics as we understand them seem to allow for events that violate what we classically thought of as the conservation of energy. As a result, some theorists think that things like Big Bangs can be fully spontaneous events—and, that, in fact, this is the best explanation for what we see. The subsequent expansion of the

4. The Hindu text *Brahmavaivarta Purāṇa* (ca. 800 BCE) asks: "And who will search through the wide infinities of space to count the universes side by side?"

universe and creation of matter would then proceed according to widely accepted principles within cosmic inflation theory.

Science is usually in the business of talking about the rules upon which one sort of event follows upon another; the spontaneous generation theory of the origin of the cosmos makes it sound as though that momentous event followed upon nothing whatsoever. There are a couple of points, however, that make this more than just a totally capricious answer. Davies points out that more and more spacetime is literally being created from nothing all the time as the universe expands—and, on a realist understanding of spacetime in relativistic physics, that expansion indeed suggests the routine generation of something from nothing. Furthermore, quantum mechanics does appear to allow for genuinely random phenomena—even the creation of elementary particles out of nothing and for no underlying reason. So the notion of the universe as "the ultimate free lunch" (in Guth's phrasing) is not as unfounded as it might sound.

Even so, it's still not clear that this idea of a universe via spontaneous generation addresses Kant's conceptual problem of a boundary to time. Where multiverse theory leaves us with multiverse time maybe stretching back forever, the spontaneous generation proposal leaves us with a first moment of time. Either option raises metaphysical problems; this dilemma was the motivation for Kant's idealist solution.

In *A Brief History of Time*, Stephen Hawking proposes a way of thinking about spacetime that may partially address our concern about having to choose between placing or not placing temporal boundaries on the universe. Like Kant, Hawking is troubled both by the proposition that the universe has always existed *and* by the proposition that it had a beginning. As we have noted, a standard relativistic model of the known universe traces its history back to a sort of ultimate compression of all matter and energy. Physics as we know

it can say little or nothing about such a state of things. This model of the history of the universe thus yields a result that presents a seemingly intractable philosophical and physical problem: The universe has a beginning in time with no preceding time; and physics cannot explain why reality itself comes into being. Neither philosophy nor physics seems able to convincingly describe, explain, or otherwise make sense of the origin of the universe.

Hawking answers with a model that describes the universe neither as infinite nor as bounded in time, called the **no-boundary proposal**. He argues that one can represent the universe's history, and the history of time itself, in such a way that it has a beginning and an end but no boundaries. His analogy compares the beginning of the universe to the earth's North Pole, and the end to the South Pole (see figure 9.2). The circumference of the globe at any given latitude represents the spatial extent of the universe. The universe is bigger in the 'middle' of its history and shrinks to a point at its ends.[5]

The key achievement of this model is that, in it, time has a beginning and end, yet without itself being bounded by anything. The North and South Poles are the 'beginning' and 'end' of the planet Earth on the longitudinal dimension, yet they are not edges or boundaries. Though Hawking's model represents the universe as

5. From *A Brief History of Time* by Stephen W. Hawking, © 1988, © 1996 by Stephen W. Hawking. (Used by permission of Bantam Books, a division of Random House, Inc. Any third-party use of this material, outside of this publication, is prohibited. Interested parties must apply directly to Random House, Inc., for permission.) This model includes a "big crunch" where, at some point in time, the universe reverses its expansion and collapses in on itself—thus the need for a South Pole in the analogy. This was not clear at the time he was writing the book, but very recent (starting in 1998) astronomical observations increasingly point to an *acceleration* in the universe's expansion. The most likely prediction, at this point, is of an ever-expanding universe that eventually reaches a state of maximal distribution of matter and dissipation of energy. In other words, the universe will eventually enter into an utterly cold and inert state, forever. If so, the 'back end' of spacetime would look to be unbounded in the sense of being infinite.

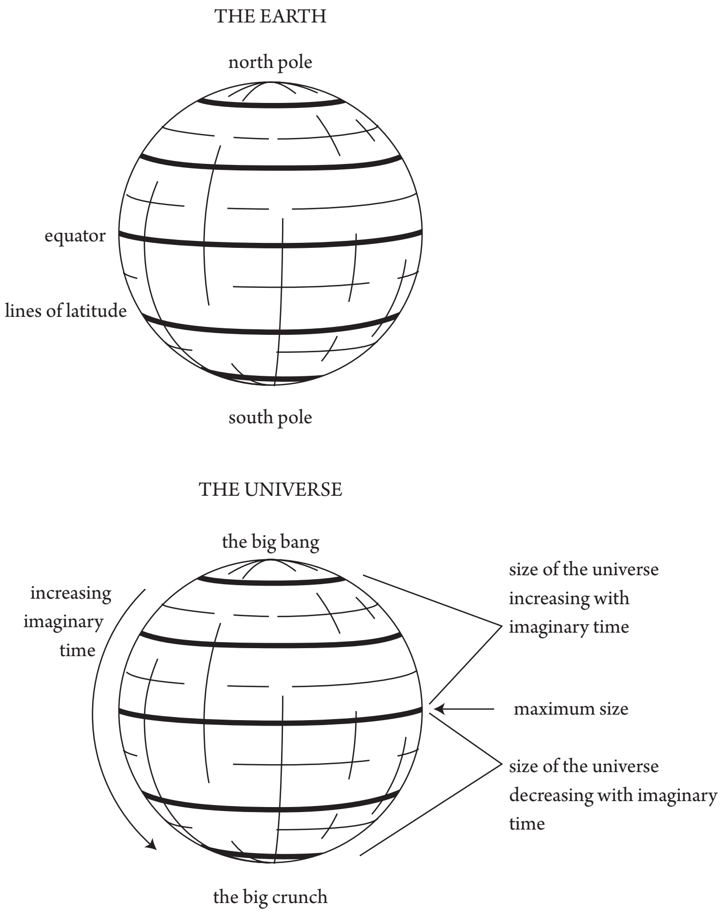

Figure 9.2. Hawking's speculative representation of a temporally self-contained universe.

finite, it does not require a 'time before time' any more than our globe requires anything on Earth to be located north of the North Pole. Further, the usual laws of physics apply at the North and South Poles, just like anywhere else. According to this model, time has, in

a sense, a first point, without requiring an edge that implies something lying on the other side.

But the Big Bang, one might reply, is an event. How can any event, even the Big Bang, not happen in time? If it does begin in time, then there must be a time preceding that moment. The surprising answer is that the Big Bang is not an event. From philosopher Bruce Reichenbach:

> [G]iven the Grand Theory of Relativity, the Big Bang is not an event at all. An event takes place within a spacetime context. But the Big Bang has no spacetime context; there is neither time prior to the Big Bang nor a space in which the Big Bang occurs. Hence, the Big Bang cannot be considered as a physical event occurring at a moment of time. As Hawking notes, the finite universe has no spacetime boundaries and hence lacks singularity and a beginning. Time might be multi-dimensional or imaginary, in which case one asymptotically approaches a beginning singularity but never reaches it. And without a beginning the universe requires no cause. The best one can say is that the universe is finite with respect to the past, not that it was an event with a beginning.

Hawking explains how the static theorist's block model of the universe naturally suggests this approach:

> In general relativity, time is just a coordinate that labels events in the universe. It does not have any meaning outside the spacetime manifold. To ask what happened before the universe began is like asking for a point on the Earth at 91 north latitude; it is just not defined. Instead of talking about the universe being created, and maybe coming to an end, one should just say: The universe is.

This would give us a universe with an earliest stage *of* time, but no beginning *in* time. This model, then, represents an alternative to both relationism and idealism that appears to neatly address our concerns about the extent of time itself.[6]

CONFRONTING OUR OWN LIMITATIONS

Though it neatly evades the old philosophical conundrum about the extent of time, the no-boundary model seems to suggest something about the universe that many have found deeply unacceptable: namely, that *there is no external reason why the universe is the way it is or why it exists at all*. The no-boundary proposal doesn't require a prior explanation of the existence or nature of the universe: The universe just BE, and it just BE the way that it BE. Nothing in this proposal brings about the beginning of time; nor is there any demand in the model for an explanation as to why the laws of nature are the way they are. The theological significance of this idea is not lost on Hawking:

> If there is no boundary to spacetime, there is no need to specify the behavior at the boundary—no need to know the initial state of the universe. There is no edge of spacetime at which we would have to appeal to God or some new law to set the boundary conditions for spacetime. We could say: "The boundary condition of the universe is that it has no boundary." The universe would be completely self-contained and not affected by anything

6. The point of all this is not that the no-boundary model is correct, but that it shows one can at least coherently describe a fully realized model of the universe, including a real spacetime, that requires no cause of the universe's existence lying either in or outside of time.

> outside itself. It would neither be created nor destroyed. It would just BE. As long as we believed that the universe had a beginning, the role of a creator seemed clear. But if the universe is really self-contained, having no boundary or edge, having neither beginning nor end, then the answer is not so obvious: What is the role of a creator?

Theists ideologically committed to the existence of a creator god don't much care for this result. What argument can they make against it? Hawking's proposal seems to violate a principle that some theologians have declared to be a necessary truth: that every actual thing has a cause of its existence, and that every positive fact has an explanation or reason for its truth. We will follow Leibniz in calling it the **Principle of Sufficient Reason**, or PSR. Belief in this principle is usually tied to belief in a divine creator: PSR is the basis for a well-known line of reasoning purporting to prove the existence of a conscious creator of the universe. Arguments of this sort are known as **cosmological arguments** for the existence of God. Notable proponents of some version of a cosmological argument include Aristotle, eleventh-century Persian-Arabic philosophers Ibn Sina and al-Ghazali; thirteenth-century Catholic theologian Thomas Aquinas; and our friend G. W. Leibniz. The argument comes in two main versions, each of which depends on PSR: the **First Cause Argument** and the **Argument from Contingency**. These two versions of the argument correspond, respectively, to the two options considered by Kant: that the universe either has a beginning in time or it has always existed. The First Cause Argument presumes that the universe had a beginning in time and claims that there must therefore be a first cause to commence the chain of events constituting the universe:

The First Cause Argument

- The universe had a beginning.
- Anything with a beginning has a cause.
- Hence, the universe had a cause.
- The only possible cause for the universe is a divine creator.
- Hence, a divine creator exists.

The Argument from Contingency, by contrast, is designed to avoid having to assume the universe had a beginning in time:

The Argument from Contingency

- Anything that exists contingently (i.e., does not exist by logical necessity) must have a reason or explanation for its existence.
- The universe exists contingently.
- Hence, the universe has a reason or explanation for its existence.
- The only possible reason or explanation for the existence of the universe involves a divine creator.
- Hence, a divine creator exists.

The first argument nicely sums up a theistic version of the rejection of the idea of bounded time without a prior cause; the second argument represents a theistic rejection of a universe that's simply been around forever without explanation.

The First Cause Argument suffers from several deficiencies. It presumes that the universe has a beginning in time; as we have seen, Aristotle and Kant each raise serious doubts that this is even a coherent option. Multiverse theory provides an alternative,

describing a greater, infinite multiverse with, perhaps, no beginning in time. Hawking's no-boundary model coherently describes a *finite* universe with no beginning in time. So it doesn't just go without saying that the universe has a beginning in time. Further, the First Cause Argument presumes that everything has a cause; but quantum physics—elements of which, at least, have been decisively confirmed—may allow uncaused events at the level of the properties, behavior, or even the existence of certain elementary particles.

The Argument from Contingency avoids some of these objections. It does not presume that the universe has a beginning: It only says that the universe may not have existed and therefore there must be an explanation as to why it does. But why must everything have a reason or explanation? (In other words, why should we think PSR is *true*?) In our everyday experience, we usually find that things are caused to happen and are therefore explicable. The facts we do investigate tend to have an explanation, so we suppose that those we don't or can't investigate have an explanation as well. But the blanket statement made by PSR remains an unproven assumption.

It is likely that natural selection has favored, for conscious reasoners like us, an instinctive presumption of *explicability*. The presumption that all events are potentially explicable encourages us to form theories about the way the world works (lightning makes fire, bison is good to eat)—theories with predictive value. Having effective theories about how the world works is a huge adaptive advantage. But theistic cosmological arguments take a thesis about events or facts *in* the world (namely, that they each have a cause or explanation) and apply it to the very existence of the world. The assumption that everyday facts always have an explanation does not automatically apply to the meta-fact that there *are* facts. Kant identified this extension of the demand for causal explanation as a

misapplication of the concept of causation. As we saw in chapter 2, for Kant the function of the concept of causation is to ground the idea that our own experiences can have a determinate order in time (via the notion of a rule-governed world that we experience). This makes causation, for Kant, strictly an 'in-world' concept; the demand for causes *among* events is not applicable to the very existence of a world of events. That issue is just not applicable to the way the concept of causation functions in cognition. Given our experience with a world of generally explicable events, it is understandable that we should naively find the question "Why is there something rather than nothing?" meaningful. But our experience does not actually give us any reason to think that this is a legitimate question. The proponent of the Argument from Contingency needs to provide a reason to think that the world itself must have an explanation.

A relatively recent variation on the cosmological argument is the **Fine-Tuning Argument**. According to the Fine-Tuning Argument, the possibility of life in the universe depends on a very unlikely set of natural laws, fundamental physical constants, and starting conditions for the universe. Had our universe exhibited different characteristics, biological life would not have been possible. Because the universe does exhibit these characteristics, proponents of the Fine-Tuning Argument conclude there must have been a conscious designer of the universe who wanted life to exist.

The Fine-Tuning Argument is an example of an **argument from ignorance**. Our early ancestors believed that gods and demons exist because there was no other explanation for storms or disease. In the pre-Darwin days, we 'knew' God must exist because there was no other explanation for why human bodies were arranged in such a way as to be alive and functional. Post-Darwin this issue presents no problem. The key assertion of the Fine-Tuning Argument is that the particular arrangement of fundamental laws and constants our

universe enjoys is inherently extremely unlikely. But there is no way to establish a priori the probability of the laws of nature themselves. The claim that certain configurations of physical constants are inherently unlikely is entirely unsupported by evidence. Further empirical investigation may someday reveal more about why the universe is constituted the way that it is, just as investigation by evolutionary biologists has revealed how biological systems have come to be so well suited to their accustomed environment. There may be some more fundamental facts, some underlying equilibria, that restrict what combinations of physical constants are possible. Further, if the multiverse idea turns out to be correct, then there would be no mystery at all as to why one universe might wind up with life-supporting characteristics: In a multiverse, innumerable sub-universes—life-supporting and otherwise—would be expected to exist. Only in the life-supporting universes could beings develop who might wonder how they got so lucky.

We haven't quite disposed of the nagging question as to why any reality—multiverse or otherwise—exists at all. Perhaps no explanation is forthcoming. We can actually say with some certainty that *not everything has an explanation*. As is often noted by philosophers of science, explanation must end somewhere. A fact about the world may be explicable by its subsumption under some natural regularity, which is itself explicable by reference to some more fundamental fact, which is in turn explained by some more fundamental natural law, and so on. But at some point, things just are the way they are. Bertrand Russell called these "brute facts". The only alternative is a chain of explanations without end. These are the only two options. Either way, you don't get an ultimate answer to everything.

The theist doesn't accept brute facts about the natural world; the theist insists on the pertinence of the question of why things are the way they are—the answer to which, furthermore, requires

a divine creator. But this question is motivated by the alleged rule that all facts must have an explanation: If that is true, then the fact of a divine creator requires one too. So, on the theist's own premises, the proposed creator cannot function as an ultimate explanation anyway.

The theist's only remaining option is to reply that the existence of a divine creator is just a brute fact about the universe with no further explanation. But if that sort of answer is acceptable, then why not stop with the fundamental laws of nature? Why can't they, and the existence of the universe, be the ultimate brute fact? That would be simpler than adding on a whole supernatural story about a creator god—a massive complication for which we have no good evidence anyway.

Furthermore, as philosopher Robert Nozick once pointed out, there are countless ways for there to be something, but only one way for there to be nothing. That makes nothing an infinitely more special state than something. The existence of *some* version of a universe is not at all surprising. Nothingness would be the miracle!

If there were a God, we could ask why there is one; if there weren't, we could ask why not. As Kant argued in his antinomies, we are capable of articulating questions that are grammatically well formed but literally have no answer. It may be that "Why does the universe exist?" is one of those questions. This is frustrating, but no one promised us that there is an answer to every question we can ask. Again, our dissatisfaction with unanswerable questions likely stems from the evolutionary advantage of having theories about how the world works and the resultant expectation of explicability. If so, such dissatisfaction has to do less with a lack of information and more with a psychological resistance to accepting things the way they are. This is a common problem; accepting our own mortality is

another example. To take Shakespeare a bit out of context, the fault, perhaps, is not in our stars but in ourselves.

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Epilogue

Is "What Is Time?" the Wrong Question?

If an answer to the question "What is time?" continues to elude us, perhaps it is because we have been asking the wrong question. *Time is not so much a 'what' as a 'how', and not so much a question as an answer*.

Time as we know it in experience is a matter of how we organize our own thoughts and perceptions; in a physical and cosmological context, it is a matter of how we can most effectively represent the universe of events. As such, time is an answer: a solution to the problem of organizing experience and creating scientific models.

So who is on the right track, the relationist, the realist, or the idealist? Each position has something to be said for it.

Relationists have a point in that much of what we have to say about time has to do with our modes of organizing and relating events. In that sense, you could call time a kind of relation. The measurement of time is possible only in terms of observed motions or changes, such as the orbit of the earth. It is for this reason, as the temporal relationist P. J. Zwart points out, that we say (albeit only

A Brief History of the Philosophy of Time. Second Edition. Adrian Bardon, Oxford University Press.
 DOI: 10.1093/oso/

metaphorically) that "time stands still" in a place where nothing changes.

Realists get support from the fact that there are, objectively, more and less successful models of reality. One of the best illustrations of this principle is the Michelson-Morley experiment (described in chapter 3) insofar as it demonstrated the superiority of the theory of relativity's conception of spacetime over Newton's absolute space and flowing time. Minkowski spacetime is part of a demonstrably superior representation of reality: It explains more and allows better predictions. The goal of the scientist is to find the most comprehensive and effective theories of natural phenomena. A theory that treats spacetime as real exhibits a good 'fit' with observation in the sense that it evinces wide-ranging explanatory and predictive power.

Idealists correctly point out that our grasp of time will always be mediated by our modes of perception and cognition. There is no way for us to step outside ourselves and directly compare our representation of nature with nature itself, to see if the former is an accurate reflection of the latter (see figure E.1). We can never penetrate to the sheer, naked reality of things as they are in themselves, unmediated by the conditions under which we experience things. Whatever we come up with as a description of nature will always reflect our own perspective on nature and never a final, unique, fully independent description.

From an evolutionary standpoint, what matters is our relationship to objects and events. No matter what metaphysical position we take on the ontological status of space and time, these dimensions provide the organizational and interactive matrix for all that matters to us: the stage for all life, thought, matter, and energy. To paraphrase Voltaire, if space and time did not exist it would be necessary to invent them.

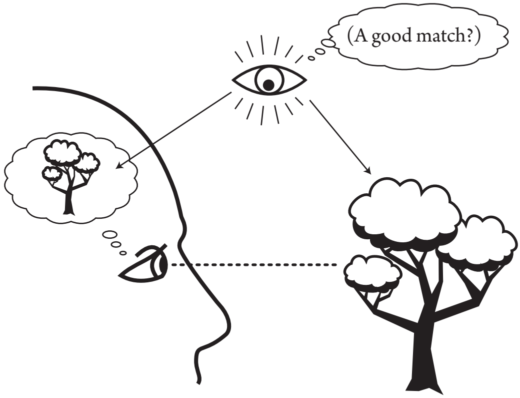

Figure E.1. A good match between representation and reality? This is a perspective we can never achieve and a comparison we can never make.

We cannot independently verify the fit of a theory with reality itself. We begin an investigation into the nature of time already constituted so as to experience the world in a certain way. Any means we could come up with to verify the accuracy of the way in which we experience the world would depend on the very same innate experiential and conceptual scheme we are trying to validate. Yet the scientific method has served us well over the last few centuries. Theories that have done well in terms of explanatory power while maintaining simplicity have the best track record regarding subsequent discoveries. It is true that we can never know the universe or its laws independently of the conditions under which we can experience them; but the guidance we can glean from reality—via the experimentally confirmed replacement of inferior models of nature with demonstrably superior ones—means that, despite inescapable limitations, we can hope to move closer to the truth.

The philosophical study of time and time awareness has yielded substantive achievements. Zeno's challenges, for example, help

us clarify what we mean by change and motion. Philosophical questions about temporal experience give us ideas about what to look for as we study the neurological bases of time perception. The logical analysis of the dynamic theory of time bolsters the physical case for the static theory. Philosophy of time leads to important hypotheses about time consciousness for evolutionary theory to pursue. Philosophical analysis of proposed explanations of the arrow of time tells us what would or would not count as a scientific solution. Philosophical reflection on the science of time travel helps us narrow down a viable metaphysics of time. The conceptual analysis of freedom, together with an appreciation of the static theory of time, shows us what free will can (and cannot) amount to; the free will discussion, furthermore, is relevant to social applications of the concepts of responsibility and justice. Finally, as we saw in chapter 9, you can't think about cosmological questions without philosophy of time.

Philosophy accomplishes the most when it works hand in hand with the empirical sciences. The field of time studies is a terrific example of this partnership. Philosophical analysis clarifies the questions that need to be addressed via empirical means; philosophical reflection helps us appreciate the significance of the results. One might have thought that time is just too obscure and intangible an issue, too much of a mystery to ever be solved. Yet the history of the philosophy of time is a history of substantial progress on this demanding subject.

SUGGESTIONS FOR FURTHER READING

The following excellent books each cover core issues in the philosophy of time. (Each was itself influential in the development of either the first or second edition of this text.) They are highly recommended for readers looking to go into more depth on various aspects of philosophy of time:

- Craig Callender, *What Makes Time Special?* (Oxford: Oxford University Press, 2017).
- Barry Dainton, *Time and Space*, 2nd ed. (New York: Acumen, 2010).
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Following are suggestions for further reading for anyone wanting a closer look at specific issues covered, respectively, in each chapter of this text.

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